DOCTORAL THESIS

Continuing technology professional development: A technology learning preferences instrument to support teacher educators' workplace learning

Schols, Maurice

Award date:
2016

Awarding institution:
University of Roehampton

Continuing technology professional development: A technology learning preferences instrument to support teacher educators' workplace learning

By

Maurice Schols BA, MA, MSc

A thesis submitted in partial fulfilment of the requirements for the degree of EdD

School of Education

Roehampton University

2015

“Professional learning does not advance… through the inexorable confirmation of previous certainties, but through a systematic challenge to our present conceptions.”

- Douglass B. Reeves -

Abstract

The knowledge-based economy, advances in information and communication technologies and new pedagogical perspectives all influence the need to improve competencies in the 21st century. Innovative educational ideas and concepts have transformed the roles of teacher educators and their students. Adequate technology training is therefore a prerequisite for the teacher educator to develop prospective teachers who can use new technologies to support and improve their students' achievement gains. However, many of these efforts fail since they are mostly based on a formal, institutional delivery of instrumental knowledge and skills. Adequate technology training is a major factor that can help to promote the uptake of emerging technologies into the curriculum, which in turn benefits students (Yoon et al, 2007; Collins & Halverson, 2009; Earley & Porritt, 2014).

This research seeks to add to current knowledge about teacher educators' technology professionalisation and to provide an instrument for the purpose of mapping teacher educators' technology learning preferences in the workplace. The technology learning preferences instrument (TLP-instrument) designed, implemented and evaluated in this research is intended to create a link between teacher-educators' technology learning needs in the workplace and the way in which professional development programmes should be tailored to meet teacher educators' evolving learning needs.

The investigation employs a design-based research approach which is cyclical and appropriate for addressing complex problems in educational practice for which no clear guidelines for solutions are available. To collect and analyse the data, a mixed methods approach was used. The rationale for mixing both types of research is that qualitative and quantitative methods complement each other (Creswell & Plano-Clark, 2011).

Findings in this dissertation and in follow-up research are intended to lead to more effective technology professionalisation programmes through suggestions for better design and development based on teacher educators' learning needs.

Contents

Acknowledgements

I would like to express my sincere gratitude to all teacher educators who gave up their precious time to share their experiences, thoughts and reflections. Without them, this dissertation would not have been possible.

This dissertation would not have been completed without the guidance and support of my two inspiring supervisors. First, I express my gratitude to my Director of Studies, Dr. Christine Lloyd, who provided invaluable direction, advice and guidance throughout the dissertation process. I will always endeavour throughout my career to reflect the standard she sets for researchers.

I would also like to thank my Co-supervisor, Dr. Jacqueline van Swet, for her critical remarks and her thoughtful suggestions during our meetings in Amsterdam and Breda. Her ideas, questions, perspectives and guidance have challenged me to widen my thinking as a critical researcher and practitioner.

I am grateful to the management board of Fontys University of Applied Sciences for financial and institutional support and for allowing me to collect data in the institution. I offer sincere thanks to Ans Buys (former director of the teacher education institution in Tilburg) for her trust in me.

I would like to thank my colleagues within the department of English for their encouragement, tolerance, moral support and patience. After my operation in 2014 especially, their support felt like a warm blanket. Special thanks go to Marina Bouckaert-den Draak, Linda Gijssen, Jeroen Hoek, Geert van Iersel, Barbara Roosken, Rita Schildwacht and Brenda de Vries for their advice and moral support in moments of uneasiness.

Finally, and most importantly, I am thankful to God for my children and wife. I consider myself fortunate to have such wonderful children, Myrthe, Chrisje (†), Ruben, and Lisa, who made me aware on the journey through the years that it is all relative. Ivonne, without your love and unlimited support, I would not have been able to see this dissertation through to completion.

Chapter 1:
Introduction

1.1 Background to the research

In today's climate of accelerating change, in which many skills become obsolete as quickly as they are learned, independent, lifelong learning and professional development are important themes in Dutch teacher education. Scholars and policymakers (Field, 2006; Collins & Halverson, 2009, Bellanca & Brandt, 2010; OECD, 2013) agree that in a knowledge-based economy, basic knowledge competencies and skills are requirements for the 21st century learner. To prepare themselves for lifelong learning, students need to develop skills in information and communication technology (ICT). The increasing interest in higher education in technical knowledge, competencies and skills is based on advances in ICT and new pedagogical perspectives on the use of technology in educational contexts. Emerging technologies such as social media and social networks allow for a large-scale form of peer-based social leaning which has led to a rethinking of education (Kwakman, 2003; Collins & Halverson, 2009). However, Cuban (1995) and Fisher et al. (2007) state that little has changed in education. The focus is still on knowledge transmission and less on knowledge construction. Several other researchers (Cox, 1997; Cox et al., 1999; Schrum, 1999; King & Newmann, 2000; Collins & Halverson, 2009; and Bellanca & Brandt, 2010) agree with these findings and emphasise that an effective uptake of ICT in education requires a major change in pedagogical practice

According to McLaughlin (1997: 79), "current theory holds that students learn best when they have the opportunity to actively construct their own knowledge", but most discussions concerning this theoretical approach have been cast primarily in terms of students' learning. Researchers, policymakers and curriculum developers have considered how to support and encourage students to develop a better understanding of subject matter by situating students' learning in meaningful contexts (Ashburn & Floden, 2006). Less attention has been paid to the teacher educators—either to their roles in developing and creating stimulating learning environments or to how they can learn new ways of teaching to facilitate 21st century learning

processes. Coto and Dirckinck-Holmfeld (2008: 54) emphasise that “one of the most important factors in any educational change is to change teachers’ practices”. How are teacher educators prepared for these new roles? Traditional training and learning approaches to continuing technology professional development (CTPD) programmes for teacher educators are mainly based on a formal delivery of knowledge (Darling-Hammond, 2006; Field, 2006; Hargreaves & Goodson, 2006; Laurillard, 2013). Fullan and Stiegelbauer (1991: 35) stated that traditional professional development programmes are full of inadequacies: “nothing has promised so much and has been as frustratingly wasteful as the thousands of workshops and conferences that led to no significant change in practice when the teachers returned to their classrooms”. The effectiveness of traditional CTPD programmes has been widely debated in the past two decades (Darling-Hammond, 1998; Schrum 1999; Holland, 2001; King, 2002; Kwakman, 2003; Kiridis et al., 2006; Collins & Halverson, 2009; Tezci, 2011) since traditional approaches have not facilitated a transformation in the use of ICT (Kirschner & Selinger, 2003; Stensaker et al., 2007; Wang, 2009).

1.2 Background and status of teacher educators’ technology professionalisation

As teacher educators are recognised as a crucial aspect of the learning environment within teacher-education institutions, facilitating their professional development regarding the use of technology is increasingly gaining attention at the level of both the Dutch national government and the management boards of teacher-education institutions. The quality of education within teacher-education institutions depends to a large extent on the quality of the teacher educators. However, maintaining and developing teachers’ ICT knowledge and skills is a responsibility shared by teacher educators and the teacher-education institution.

In 2008, the Dutch Minister of Education, Culture, and Science and Dutch teacher-education institutions decided that practicing teachers in secondary schools as well as teacher educators needed to acquire proficient ICT knowledge and skills to accommodate the learning needs of students preparing for the 21st century workplace and society. Instruction for teacher educators on topics related to technology development has often been organised around formal ways of learning which have aimed primarily at providing them with necessary ICT knowledge and skills. However, several studies show that such formal programmes do not provide the most

fruitful learning opportunities and indicate that technology professional development programmes are often perceived by teachers and teacher educators as disconnected, fragmented and sporadic. Given the need for improved technology education, several research groups within the researcher's teacher-education institution have started to investigate what learning environment or professional learning opportunities best cater to teacher educators' technology learning needs.

The subject of this research therefore originates from an urgency felt in one particular Dutch teacher-education institution to investigate teacher educators' technology learning in the workplace. The investigator for this doctorate research, a teacher educator and professional technology learning facilitator, heeded the call and created an opportunity for the teacher-education institution to explore teacher educators' professional learning.

Several research groups within the target teacher-education institution have been studying learning phenomena such as formal and informal learning and collective and individual learning opportunities. The learning concepts which are currently important within the teacher-education institution and the researcher's own practice were chosen as the variables central to the dissertation research.

1.3 Rationale for not choosing TPACK as the conceptual framework in this research

To effectively integrate technology use into their teaching practice, teacher educators need to better understand the pedagogical benefits and limitations of ICT in educational contexts. In the past two decades, several frameworks have been developed which have contributed to an increase in ICT education. One such framework introduced to the educational technology field was the TPACK model, developed by Mishra and Koehler (2006). Building on Shulman's (1986,1987) studies, Mishra and Koehler (2006) presented pedagogical content knowledge (PCK) as one of four foundational concepts with which teachers should be equipped. TPACK is a framework which helps teachers and teacher educators understand and examine the versatile forms of knowledge and skills required to effectively integrate ICT in the classroom (Mishra & Koehler, 2006). Although the TPACK framework has been adopted in a multitude of educational contexts and is considered to have shown promising results in promoting the integration of

technology in teachers' practices, facilitating broad acceptance of ICT is a complex process and requires a profound understanding of multiple factors (Koehler et al., 2007).

An important factor in enabling active application of ICT involves the way in which teacher educators prefer to acquire new technology knowledge and skills. Within the Dutch educational system, increasing attention is being paid to continuing professional development programmes which might foster technology use in educational practice. However, as noted in Chapter 2, professional development on technology use often is undertaken through formal education activities, and although these formal approaches might contribute to technology professional learning, the transfer of knowledge and skills to the classroom remains problematic (Knight, 2002). In other words, in general, the professional training opportunities teacher educators currently receive is "episodic, myopic, and often meaningless" (Darling-Hammond, 2009: 2).

In an attempt to contribute to the understanding of teacher educators' professional technology learning preferences, rather than using TPACK as a conceptual framework for the design of the TLP-instrument, different learning concepts that are currently employed within Dutch teacher-education institutions were used. Specifically, concepts such as formal and informal learning and individual and collective learning are further explored as they relate to teacher educators' preferences for ICT instruction.

1.4 Definitions of terms

Before discussing the rationale and major themes that are addressed in this dissertation, it is important to define the following terms, which are included because the decision to use these terms has informed—and to a considerable extent, shaped and affected—the discussion and content of this thesis.

Technology professional development – Includes a range of activities, which may be institution-based or provided off campus, to help teacher educators learn new skills and pedagogical insights to explore new or advanced understandings about using ICT in educational contexts, so that they can provide student teachers with rich and effective learning environments.

Workplace learning – The process of learning knowledge and skills that are related to teacher educators' teaching practice.

Formal learning – Learning that is provided by an education or training institute and has a prescribed learning framework in terms of time, support and learning objectives, which leads to an award or certification.

Informal learning – Learning resulting from daily activities that occur without imposing pre-set learning objectives, which does not typically lead to an award or certification.

Individual learning – Individual learning is learning that can be defined as the capacity to build knowledge through individual reflection about external stimuli, and through the personal re-elaboration of individual knowledge and experiences (Forcheri et al., 2000).

Collective learning – Learning that occurs when several learners of different capabilities and interests work together but not necessarily with the same learning output.

Design research – The systematic study of designing, developing and evaluating educational interventions (e.g., programmes, teaching-learning strategies and materials, products and systems) as solutions for complex problems in educational practice, which also aims to enhance knowledge of these interventions' characteristics and the processes of designing and developing them (Van den Akker, 2006; McKenney & Reeves, 2012)

Mixed methods – "As a method it focusses on collecting, analysing and mixing both quantitative and qualitative data in a single study or series of studies" (Creswell & Plano-Clark, 2011: 5).

1.5 Aim of the research

The general aim of this research is to contribute to the body of knowledge in the field of teacher educators' CTPD. The objective is to design and develop a technology learning preferences instrument which can be used in designing, developing and assessing future CTPD-programmes with regard to teacher educators' technology learning preferences. The research investigates teacher educators' technology professionalisation in the workplace based on two dimensions: whether learning is formal or informal and whether it is individual or collaborative. The degree of formality and the extent to which learning is collective can be considered a spectrum where learning can combine formal and informal methods. Consecutive prototypes of

the instrument will be designed and constructed, implemented, evaluated and readjusted to improve the design and contribute to theory (Van den Akker, 1999; Van den Akker et al., 2006; Plomp & Nieveen, 2010). The research aims are:

- To provide insight into factors in formal and informal learning situations which influence teacher educators' technology professional development
- To provide insight into teacher educators' collective learning in (virtual) communities of practice
- To provide insight into the design and development of a technology professional learning preferences instrument that can be used to design and develop future CTPD programmes for teacher educators
- To produce knowledge that can support professional development providers, management boards and teacher training institutes in the Netherlands (1) to recognize the need for CTPD, (2) to gain awareness about teacher educators' personal needs and with regard to implementing CTPD programmes, (3) to gain more insight into processes associated with CTPD learning activities in the workplace, and (4) to provide direction in designing, developing and assessing teacher educators' CTPD programmes
- To gain and develop knowledge and skills in the field of teacher educators' technology professionalisation which can be of use in designing, developing and assessing future CTPD programmes.

1.6 Theoretical perspectives

According to constructivists, learning is an active and constructive process in which learners generate new knowledge and meaning to add to prior knowledge from the interaction between their experiences and ideas. Central to constructivism is its conception of learning as proposed by constructivist theorists such as Brunner, Dewy, Piaget, von Glasersfeld, and Vygotsky. Von Glasersfeld (1995: 14) considers learning as "a process of self-regulation and the building of conceptual structures through reflection and abstraction". Previously acquired knowledge and beliefs and ideas about how learning occurs play a crucial part in the way learners acquire new knowledge and skills (Pintrich et al., 1993). From a constructivist perspective, it is essential to

pay attention to the views, ideas and learning preferences that learners have with regard to their own learning process.

Much of the research on student learning holds that students enhance their learning best when the learning environment is supportive, constructive and authentic (Lombardi, 2007; Bryk et al., 2010; McLoughlin & Lee, 2010; Herrington et al., 2014). Discussions about these ideas have centred on students, and the majority of these studies on student learning conceptions focus on general beliefs and assumptions (Vermunt, 2005; Bliuc et al., 2007; Means, 2010). Learning may vary due to contextual differences and students' learning preferences (Linnenbrink & Pintrich, 2003; Vermunt, 2005; Romanelli et al., 2009), but few empirical studies have examined the role of teacher educators' technology learning preferences with regard to professional learning in the workplace.

1.7 Statement of the problem

Because teacher educators are recognised as a crucial aspect of the learning environment within schools and their students' development, technology professional development is considered essential for educational reform (Ashburn & Floden, 2006; Collins & Halverson, 2009). As a result, facilitating teacher educators' technology learning is increasingly gaining the attention of national and international governments and higher education policymakers (Becta, 2008; Kennisnet, 2011; OECD, 2013; ISTE, 2015).

The majority of technology professional learning occurs within schools and in formal settings, where there are many different views about provision. There is a prevalent dissatisfaction with traditional CTPD programmes which do not take into account the specific educational contexts in which teacher educators need to work (Ashburn & Floden, 2006; Collins & Halverson, 2009; Bellanca & Brandt, 2010; Hartley et al., 2011; Van Driel & Berry, 2012). Various CTPD programmes are situated in the workplace but fail to provide learners with "just-in-time" (Schrum, 1999: 85) knowledge and skills, resulting in a general discontent. What Schrum (1999) argues is that teacher educators should be provided with opportunities to acquire knowledge and skills that are based on authentic reasons and which are applicable to their daily learning needs. Many CTPD programmes are poorly planned and organised since teachers "lack time and opportunities to view each other's classrooms, learn from mentors, and

work collaboratively" (Hunt, 2009: 2). Current technology learning trajectories lack opportunities in which teacher educators are engaged in acquiring new knowledge and skills with regard to the potential pedagogical benefits of using ICT in their teaching practice.

The core issue in the literature (King, 2002; Harris et al., 2009; Kennisnet, 2011; ISTE, 2015) seems to be that teachers need to be at the centre of their technology learning if they are to reconceptualise their traditional beliefs and habits regarding technology use in their classrooms. School leaders, policymakers and professional development facilitators should therefore ensure that CTPD opportunities are designed according to the learners' needs.

In the context of this research, adequate technology training seems to be a major factor that can help teacher educators to integrate technologies in their own teaching practice (US Department of Education, 2005; Kennisnet, 2011). As Roberts (2003) suggests, for ICT to be integrated effectively and more frequently in educational settings, teacher education institutions need to surpass basic technology skills and knowledge development. In other words, adequate CTPD can be seen as a prerequisite for the 21st century teacher educator.

The technology learning preferences instrument (TLP-instrument) in this research is intended to create a link between teacher educators' learning preferences and the way in which they critically evaluate their continuing technology professional learning in the workplace. In practice, the model recognises educators as both learners and agents of change and requires them to think deeply and carefully about their technology learning.

1.8 Research questions

Based on the research aims, the following research questions are the focus of this research:

1) What kinds of formal and informal technology learning activities and contexts do teacher educators currently prefer as part of their technology professionalisation?

2) What kinds of individual and collective learning activities and contexts do teacher educators currently prefer as part of their technology professionalisation?

3) What strategies and factors promote teacher educators' technology learning in the workplace?

4) How can a TLP-instrument be designed for technology professionalisation based on teacher educators' preferences regarding the level of formality and the degree of collectivity in their learning processes?

1.9 Significance of the research

In the current, knowledge-based society, professionals in the field of education are required to pay constant and close attention to the latest pedagogical developments, to anticipate emerging technology and to increase their technology knowledge and skills (Hargreaves, 2003; Van Veen, 2009; Ertmer & Ottenbreit-Leftwich, 2010). To support teacher educators' continuous technology development, the prerequisite is an understanding of how they learn in the workplace. Consequently, teacher educators' technology learning has become an important topic in the field of higher education (Collins & Halverson, 2009; Darling-Hammond 2010; Van Driel & Berry, 2012). In several studies (Biggs, 1999; Boekaerts & Minnaert, 1999; Fried, 2008; Biggs & Tang, 2011; Barker et al., 2013) the focus is on student learning or in-service teacher learning that is mostly organised off campus and outside of the teaching practice. In the past decade, a growing interest in workplace learning has arisen (Evans, et al., 2006; Billett, 2009; Mezirow & Taylor, 2011; Evans et al., 2014), and these studies found that situating teacher educators' technology professional development in the workplace can foster positive attitudes toward using emerging technologies based on newly acquired knowledge and skills. Yet, an extensive literature review revealed that little is known about the preferred learning methods which contribute to the uptake of technology in educational contexts.

Gaining more insight into how teacher educators prefer to learn to use emerging educational technologies in their teaching and learning contexts and what factors and barriers contribute to learning is critical in designing and evaluating a TLP-instrument which can be used to map teacher educators' preferred learning methods.

1.10 Local setting of the research

The research has been developed and conducted in the context of a Dutch teacher education institution which is a university of applied sciences. The research participants that participated in the different research phases were 103 teacher educators working in three different main

interdisciplinary teams which consisted of six sub-teams. Table 1.1 presents an overview of the composition of the three main interdisciplinary teams with the six sub teams.

Table 1.1 *Overview three interdisciplinary teams with the six sub teams (N = 103)*

Team Alfa	Team Beta	Team Gamma
- English and German	- Economics and math	- History, geography and social science
- French, Dutch and Spanish	- Physics, chemistry, science, and technology	- Interactive skills, healthcare, and biology

1.11 Overview of the methodology

The anticipated instrument developed as part of this research is intended to create a link between teacher educators' technology learning preferences and the way in which they critically evaluate their CTPD in the workplace. The research employs a design-based approach (Van den Akker et al., 2006; McKenney & Reeves, 2012) that is cyclical in nature and in which analysis, design, evaluation and revision of activities are iterated "until a satisfying balance between ideals ('the intended') and realisation has been achieved" (Plomp & Nieveen, 2010: 21). According to Plomp and Nieveen (2010: 9) "design research is suitable to address complex problems in educational practice for which no clear guidelines for solutions are available". In the field of learning sciences, the belief that context matters leads to the conclusion that traditional research paradigms which simply examine learning processes as isolated variables will "lead to an incomplete understanding in naturalistic settings" (Plomp & Nieveen, 2010: 10). A design-based approach enables the systematic adjustment of various aspects of the designed contexts to test and generate theory and to contribute to improving educational practice.

1.12 Design-based research approach

Design research usually includes the phases of preliminary research, prototyping and evaluation. In this study, the preliminary stage encompasses a needs and context analysis of teacher educators' technology professional development and the development of a conceptual framework. During the prototyping and evaluation phases, based on iterations, each micro-cycle

of research will be formatively evaluated to refine or improve future prototypes. During the assessment phase, an evaluation of the design will be used to assess whether the solution or intervention meets the specific requirements (Van den Akker et al., 2006) for the design of a prototype TLP-instrument.

1.13 Mixed methods

For the purposes of triangulation and the acquisition of in-depth knowledge (Miles & Huberman, 1994), the data will be obtained using several instruments. The mixed methods approach was chosen because neither quantitative nor qualitative methods alone are sufficient to answer the research questions. When used in combination, qualitative and quantitative methods complement each other (Creswell & Plano-Clark, 2011). The triangulated mixed-methods design involves a procedure for collecting, analysing, and integrating both quantitative and qualitative data in a single phase design, in which all data is used to answer the research questions (Creswell & Plano-Clark, 2011). Qualitative data will be collected within a pragmatic paradigm using a phenomenological approach since the research seeks to have an influence on reality through acquiring practical knowledge of teacher educators' technology learning in the workplace.

To collect data concerning Research Questions 1 and 2, all 179 teacher educators working at the teacher education institution will be asked to complete a questionnaire during the preliminary research phase. The questionnaire will mainly examine teacher educators' basic attitudes and opinions about their technology learning in the workplace. To obtain more profound information on *what* and *how* participants prefer to learn, 11 semi-structured interviews will be conducted. The findings from the web-based questionnaire and the semi-structured interviews during the preliminary research phase will be inductively analysed and used to design a prototype instrument.

Yin (2003) encourages researchers to use multiple sources of evidence, such as data from questionnaires, semi-structured group interviews and reflective reports. Therefore, different instruments will be used during the prototype and evaluation phases to collect and analyse data. To obtain information about teacher educators' learning preferences as stated in Research Questions 1 and 2, the TLP-questionnaire which is part of the TLP-instrument will be

used to map individual learning preferences and related learning activities. Like the web-based questionnaire used during the preliminary research phase, the TLP-questionnaire will be administered before the semi-structured interviews are conducted. In this way, the quantitative and qualitative data will be triangulated.

During the qualitative phase, semi-structured interviews will be conducted to help explain why certain technology learning factors may be significant predictors of teacher educators' learning preferences. In this context, the use of mixed methods provides more evidence for studying the research problem than either quantitative or qualitative approaches alone (Creswell, 2002).

The results and interpretation of the quantitative and qualitative data during the preliminary design research phase will be used to develop and set up micro-cycles of data collection and analysis during the prototyping and evaluation phase. The results of these micro-cycles will be used to develop a more profound understanding of teacher educators' learning preferences in order to develop and refine a prototype TLP-instrument.

1.14 Structure of the dissertation

Chapter 2 provides details of several theories and research contexts that have led to the theoretical framework concerning technology learning in the workplace. After defining several essential terms, the chapter discusses teacher educators' professional development and related contexts. The chapter considers the level of formality and collectivity in the learning process. Additionally, factors which promote or impede teacher educators' technology professional learning will be discussed.

Chapter 3 details the research methodology by first clarifying the epistemological assumptions on which this research is based. Next, the chapter discusses the philosophical stance that lies behind the chosen methodology. An attempt will be made to explain in what way interpretivism provides a context for the research design. The chapter offers further details about design-based research as an appropriate methodology and demonstrates how it is informed by grounded theory. The methods and instruments that will be used to collect and analyse data will also be discussed.

Chapter 4 discusses the processes of data collection and analysis and critically reflects upon the processes used to answer the research questions.

The quantitative and qualitative findings of the preliminary research phase are integrated and presented in Chapter 5. The first part of the chapter is dedicated to the results from the web-based questionnaire explicating the four preferred methods of technology learning revealed in the comprehensive literature review discussed in Chapter 2. The second part of the chapter will present and discuss the results from the semi-structured interviews which informed the design of a TLP-model.

Chapter 6 is devoted to a discussion of the design, implementation and evaluation of the TLP-instrument during the three subsequent prototype phases. The design of a prototype TLP-instrument is based on the concept model (Figure 5.2, Chapter 5). This model postulates the existence of four combined learning methods found during the preliminary research phase as discussed in Chapter 5. Chapter 6 discusses and evaluates the insights that emerged during the three prototype and evaluation phases which led to the refinement of the TLP-instrument and to a better understanding of teacher educators' learning in the workplace.

Chapter 7 summarises the main findings and overall conclusions based on the investigation during the preliminary research phase and the three prototyping and evaluation phases. The chapter includes reflection on the conceptual framework, methodological considerations, and practical implications for higher education and suggestions for further research.

Chapter 2:

Teacher educators' workplace learning and technology learning preferences: A theoretical framework

2.1 Introduction

In the past few decades, society and institutions for education, have placed more emphasis on the importance of teacher educators' technology professional training and development in the workplace (Collins & Halverson, 2009; ISTE, 2015). In today's world, changes in educational contexts and a growing need for trained teacher educators forces many teacher education institutions to reconsider their teacher educators' role, and in what way they can be equipped with the needed technology knowledge and skills to fulfil "the new demands being placed upon them" (Matthews, 1999: 18). "Despite this recognition of the need to improve" teacher educators' knowledge and skills about emerging technologies, "the issue of workplace learning" is fraught "with confusion and indecision" (Matthews, 1999: 18). Technology learning in the workplace is an extremely complex process (Eraut, 2004) and involves more than simple skills training (Darling-Hammond, 2006; Evans et al., 2006; Glasset & Schrum, 2009). A better understanding of teacher educators' technology "workplace learning requires the integration of a range of diverse factors" (Matthews, 1999: 18) that in combination can improve technology learning in the workplace. The discussion in the following sections elaborates on the necessary factors for workplace learning.

This chapter explores the literature on various approaches to teacher educators' technology professionalisation in the workplace. The review of the literature is divided into seven main sections. The first three sections focus on the importance of CTPD, new perspectives on teacher educators' CTPD, and the qualities that define a digitally literate teacher educator are discussed to provide a background for the following sections. The following three main sections examine CTPD strategies, barriers and factors that inhibit technology learning. The final sections focus on levels of formality and collectivity in workplace learning.

2.2 The importance of CTPD

The digital revolution has had an enormous impact on our daily lives (Sloep & Jochems, 2007; Collins & Halverson, 2009). New technologies are transforming every aspect of life and education, and research communities are abuzz with new ideas about the use of emerging technologies in teaching and learning (Collins & Halverson, 2009). Scholars and policymakers agree that students need basic competencies in areas such as reading, writing and numeracy, but in addition to these basic competencies, students need to develop skills which prepare them for lifelong learning in an information and communications-based society (Collins & Halverson, 2009; Bellanca & Brandt, 2010). The interest in these technical competencies stems from advances in ICT and new pedagogical perspectives on the use of technologies in the classroom. New developments in technologies have often played a critical part in educational reform (Collins & Halverson, 2009; Tezci, 2011) and are seen as an integral component in school curricula (Niederhauser & Stoddart, 2001; Kirschner & Selinger, 2003; Al-Mahmood & Gruba, 2007; Shahmir et al., 2011).

Technology supporters use two arguments to demonstrate how emerging technologies will revolutionise education (Collins and Halverson, 2009). One argument is that the digital revolution has changed society in many respects, for example, the way in which we communicate and acquire information. According to Kirschner and Selinger (2003: 5):

> "Computers are substantially different from any previous technologies because multimedia and hypertext give access to new ways of thinking through dynamic images, simulations and models, and the Internet provides access to the huge array of previously untapped information."

The other argument is that emerging technologies offer the means to improve teaching and learning (Lefebvre et al., 2006), which should be embraced by educational institutions in targeted reform efforts to provide students with rich learning environments. Material wealth has great value in an industrialised society, but knowledge, information and the way in which information can be collected are key aspects of an information and communications society. According to Collins and Halverson (2009: 9), technology and the information age "will radically transform the way schools educate students". Technology also provides many tools and mechanisms to enhance learning, such as virtual learning environments, Internet platforms,

Smart Boards, and social media (Merriam et al., 2007). New technologies make it possible to customise education to learners' needs which requires not only a new perspective on learning with technologies but also a new perspective on teaching. As a result, teacher educators need to learn new ways of teaching with ICT, which in turn demands effective CTPD programmes.

2.3 New perspectives on teacher educators' CTPD

Fisher et al. (2007) argue that little has changed in education since teaching and learning continue to be perceived as a matter of teacher-to-student knowledge transfer rather than a student-centred model in which students are expected to be in control of their own learning process.

New technologies make it possible to change education in such a way that it may start a "learning revolution" (Resnick, 2001: 1). Yet, a push for technology alone does not guarantee a revolution (Resnick, 2001; Collins & Halverson 2009). The superficial use of technologies in education has raised questions about their effectiveness since most teacher educators adhere to 20th century pedagogy and methods, and have not been trained to create stimulating learning environments by utilising emerging technologies. This argument is in line with Borko (2004: 3), who states that "despite recognition of its [technology's] importance, the professional development currently available to teachers is woefully inadequate".

Most of these discussions and assumptions about the role of technology have been cast primarily in terms of students. Researchers, policymakers and curriculum developers have considered, for example, how to support students in developing a deeper understanding of subject matter and to situate their learning in meaningful learning contexts (Ashburn & Floden, 2006; Lombardi, 2007; Sadler, 2009; Collins & Halverson, 2009; Kirkwood & Price, 2014). Theorists have considered how students learn, for example: "current theory holds that students learn best when they have the opportunities to actively construct their own knowledge" (McLaughin, 1997: 79). Yet, less attention has been paid to teacher educators, either to their new roles in developing and creating enriched learning environments or to how they learn new teaching methods tailored to students' individual learning preferences. According to Coto and Dirckinck-Holmfeld (2008: 54), "one of the most important factors in any educational change is

to change teachers' practices". Therefore, effective CTPD programmes play a pivotal role in successful technology integration.

How are teacher educators prepared for their new roles? They are required to "find ways of harnessing the power of the new technology" (Kirschner & Selinger, 2003: 6). Yet, traditional training and learning approaches in CTPD programmes for teacher educators are mainly based on a formal delivery of technology knowledge and skills and are limited to attending workshops, courses or ICT conferences. The sufficiency of these traditional CTPD approaches, however, has been debated recently (Schrum, 1999; Holland, 2001; Daly et al., 2009; Harris et al., 2009; Darling-Hammond et al., 2009) since traditional approaches cannot address the increasing demand on teacher educators to integrate emerging technologies in their practice to create rich learning environments for their students (Robinson & Latchem, 2003; Kirschner & Selinger, 2003; Collins & Halverson, 2009).

In my own roles as a teacher educator and an ICT facilitator, I have frequently observed that various CTPD programmes are situated in the workplace but fail to provide teacher educators with "just-in-time" (Schrum, 1999: 85) or learning activities or opportunities that meet the learner's technology learning needs. As a result too often CTPD programmes are ineffectual (McLeod & McLeod, 2004; Ashburn & Floden, 2006; Collins & Halverson, 2009). Most educational institutions foster programmes that aim at "just-in-case" learning (Maistre & Paré, 2004; Traxler, 2009), while emerging technologies foster "just-in-time" learning. An investigation into what makes CTPD programmes successful should therefore focus more on how to cater to the teacher educator's learning needs (MacDonald, 2008).

Educational institutions and teacher educators are aware of the need for more flexible and effectual CTPD programmes "that ensure pedagogically sound teaching use of [emerging technologies] in [teacher educators'] classroom[s]" (King, 2002: 284). How teacher educators should learn in the workplace, however, is still not clear, and descriptions of learning methods are in most cases too general or insufficient for the scope of the technologies (Kwakman, 2003; Meirink et al., 2009). Many CTPD programmes seem to focus on a general audience and do not take into consideration the learning needs of the individual learner. Too often CTDP programmes lack an ongoing process of learning in which teacher educators have opportunities to reflect on their learning (Collins & Halverson, 2009).

To provide student teachers with meaningful learning that prepares them for the 21st century requires that teacher educators are able to provide learning that is directed toward achieving learning outcomes that focus on a changing society in which technologies are transforming every aspect of life. Using emerging technologies adequately, teacher educators need basic ICT knowledge and skills, and they need to know how to use them in order to improve their students' learning (Kirschner & Selinger, 2003; Zhao, 2003; Hughes, 2005).

2.4 Teacher educators' digital literacy

Teacher education institutions are confronted with the challenge of how to transform the curricula and teacher educators' CTPD trajectories to equip student teachers with 21st century knowledge and skills (Sife et al., 2007; Darling-Hammond, 2010). To meet these challenges, teacher education institutions must embrace emerging technologies and new pedagogical approaches to design new learning opportunities and environments which support state-of-the-art learning. ICT can provide an array of functional tools which may help transform traditional classrooms and learning processes into rich learning environments (Bonk et al., 2006; Ertmer & Ottenbreit-Leftwich, 2010; Unesco, 2010).

Although emerging technologies are "not a panacea for all educational" (Kirschner & Selinger, 2003: 5) reforms, teacher education institutions have a greater awareness of the need to integrate ICT standards and guidelines for supporting teacher educators' professional development. Traditional CTPD programmes must undergo rapid changes to meet educators' need to develop "future teachers who know how to use modern learning technologies to improve student learning." (Kirschner & Selinger, 2003: 6). As discussed earlier, teacher educators' technology professionalisation has been emphasised in research reports and policy documents as "the single most important step" (Culp et al., 2003; Groth et al., 2007; as cited in Lei, 2009: 87) toward integrating emerging technologies in education, and professionalisation is a crucial factor of educational reform (Kozma, 2005; Tondeur et al., 2008; Van der Linde et al., 2012). Many projects and initiatives have been developed to improve teacher educators' technology knowledge and skills. For example, in the Netherlands, Surffoundation, which is a collaborative ICT organisation for Dutch higher education and research, dedicated specific grants between 1999 and 2006 to the promotion of technology innovation projects for higher

education. In the United States, Project Tomorrow (2008) supports the innovative use of technology resources in education. Yet, recent research shows that educational institutions have not achieved a high level of emerging technology use (Mueller et al., 2008; Hennessy et al., 2010; Tondeur et al., 2010).

The important questions raised then, focus on why traditional CTPD approaches have not contributed to an increase of using new technologies in practice and why current CTPD trajectories do not meet the learners' needs (Bingimlas, 2009). Addressing these questions will contribute to a better understanding of teacher educators' technology learning, which is the aim of this research. One reason for the failure of technology to change education on a large scale at teacher education institutions is that most teacher educators currently use basically the same teaching methods as their predecessors. As discussed earlier, most CTPD programmes are based on a "just-in-case" model (Schrum, 1999; Lawless & Pellegrino, 2007; Glasset & Schrum 2009), which does not match teacher educators' technology learning needs. Most teacher educators' CTPD programmes focus on the technology itself without paying enough attention to how it could be effectively used in teacher educators' practices (Zhao et al., 2002; Mishra & Koehler, 2006; Lei, 2009). In the context of this research, digitally literate teacher educators are crucial in fostering a successful integration of emerging technologies in teaching and learning. Therefore, it is necessary to define what is needed to be a digitally literate teacher educator before examining different approaches to learning needs.

The development of digital literacy as a concept dates back to the early 1990s when personal computers were introduced and many households obtained their first analogue Internet connection through a dial-up access procedure. Prensky (2001) coined "the term *digital natives* to describe the younger generation who has grown up with technology" (Lei, 2009: 87). That term and several related terms such as the *Net Generation* (Oblinger & Oblinger, 2005) and *Homo Zappiens* (Veen & Vrakking, 2006) have been used in research reports to differentiate between the more digitally aware students and their parents and teachers. A 2013 OECD report found that most of these digital natives had acquired technology knowledge and skills outside of the classroom since most of them had access to a computer with an Internet connection at home. These digital natives acquired knowledge and developed technology skills that "grew exponentially, … largely outperforming those of their teachers" (Pedro, 2007: 25).

Because digital natives were raised with technologies such as computers, the Internet, smartphones and social media, most of them have become more adept at using these emerging technologies in learning (Kirschner & Selinger, 2003; Dede, 2010). As they participate in discussion groups, creating their own avatars and interacting between real-world and in-world environments and activities, they assimilate new knowledge and skills. Research also shows that these digital natives learn differently than their teachers do (Oblinger & Oblinger, 2005; Prensky, 2006; Powell, 2007: Sheehy & Clough, 2010), which positions the latter as "digital immigrants" (Prensky, 2001) who "speak the technology language with attitudes and accents" (Lei, 2009: 87). Researchers have portrayed digital natives optimistically as educational innovators who can foster educational reform and further advance society (Prensky, 2005; Palfrey & Gasser, 2008; Hoffman, 2010).

Researchers in the education field claim that the digital natives represent a new generation of learners entering educational institutions, who have grown up with new technologies "as an integral part of their everyday lives" (Matthews, 1999: 19; Jeffrey et al., 2011: 384). These students' use of ICT "differentiates them from previous generations of students and from their teachers" (Bennett et al., 2011: 777) and the differences are so significant that the nature of education "must fundamentally change to accommodate the skills and interests of these digital natives" (Prensky, 2001 as cited in Vernacchia, 2012: 3). In response to the changing technology skills of students and education systems that were designed to teach less digitally aware students, a rethinking of education is underway, which has implications for teacher educators' CTPD programmes. Thus, there is "a pressing need for theoretically informed research" about teacher educators' technology learning (Bennett et al., 2008: 776).

Using emerging technologies in educational contexts necessitates technology development programmes which comply with new pedagogical technology knowledge and skills. As teacher educators need to learn new teaching methods which meet their students' 21st century learning needs, teacher educators are assumed to learn in the same way that their students do. Teacher educators also have to construct their own technology knowledge and skills, necessitating technology professionalisation programmes that fit their learning needs. The focus of this research is to investigate and analyse which technology learning methods and

activities teacher educators prefer and the factors and strategies that contribute to their learning in the workplace.

2.5 CTPD Strategies

Researchers (Tondeur et al., 2007; Collins & Halverson, 2009; Bellanca & Brandt, 2010) state that the use of technologies in educational contexts is a prerequisite for developing the knowledge and skills that are needed in a 21st century society, and confirm that many efforts have been made to contribute to the uptake of ICT in the classroom (Bingimlas, 2009: 237-238). The findings in these studies reveal that traditional CTPD strategies have failed to educate teachers on adequate ICT integration (Schrum, 1999; Holland, 2001; OECD, 2004; Tondeur et al., 2007; Daly et al., 2009; Tezci, 2011). In other words, the use of ICT alone may not be sufficient to generate changes in teaching and learning, indicating a need for CTPD strategies that are tailored to teacher educators' technology learning.

Traditional technology development strategies used in schools and universities are grounded in a model of formal education that separates learning from doing (Cranton, 1996; Johnson, 2001; Penuel et al., 2007). Many of these formal professionalisation opportunities are conducted outside of the educators' teaching and are structured in a workshop format. Although these workshops are intended to include experiential and hands-on learning, too often these workshops can be described as a session in which an expert exchanges ideas or demonstrates a specific application or technique. Most of these formal educational strategies are often insufficient to stimulate CTPD programmes (Clarke & Hollingworth, 2002), and many have a history of being short term and disconnected from practice (Hoban, 2002; Ashburn & Floden, 2006; Van Es, 2009). To improve CTPD practices which contribute to teacher educators' technology learning, technology development strategies should focus more on work-based learning and activities which bring professionals together (Tynjälä et al., 2003; Lieberman & Pointer Mace, 2008).

During the last two decades, research has focused on CTPD strategies which provide teacher educators with opportunities that contribute to their technology learning by creating networks in which they can interact (Wilson & Berne, 1999; Garet et al., 2001; Little, 2006; Lieberman & Pointer Mace, 2008). Studies have indicated that CTPD approaches are more

effective when participants can learn together (Wenger, 1998; Wenger et al., 2002; Darling-Hammond, 2006; Little, 2006; Webster-Wright, 2009). The concept of these learning communities has become popular in several academic disciplines such as organisational studies and education (Wenger et al, 2002: Borko, 2004; Chalmers & Keown, 2006; MacDonald, 2008). Communities of practice (CoPs) "embed learning in activity and make deliberate use of social and physical contexts that contribute uniquely to teachers' knowledge base, professionalism, and ability to act on what [teacher educators] learn" (MacLaughlin & Talbert, 2006: 5). The CoPs view of learning is based on sociocultural theories (Foulger, 2004: 3), and the social system within the community is a key asset because it assists the organisation or institution in exchanging and interpreting information across organisational boundaries and retaining knowledge in authentic ways, which makes knowledge meaningful to participants. However, many CTPD programmes which are based on these strategies still focus on delivering content rather than enhancing technology learning, and although CTPD programmes have become "more engaging and interactive, many remain episodic updates of information delivered in a didactic manner" (Webster-Wright, 2009: 703). The ineffectiveness of current strategies in improving teacher educators' CTPD signals a need to design more meaningful approaches to supporting their CTPD (Ashburn & Floden, 2006; Collins & Halverson, 2009).

The discussion in this section provides important insights into the deficiencies in CTPD. As research question 3 in this study focusses on which factors foster or impede technology professionalisation, the following section will briefly discuss the factors that have been identified in several studies on the integration of ICT in teaching and learning contexts.

2.5.1 Barriers in teacher educators' CTPD

In several studies, different categories are used to describe barriers to teachers' use of emerging technologies (Anderson et al., 1998; Ertmer, 1999; Cuban, 2001; Butler & Sellbom, 2002; Markauskiate, 2007; Li & Kirkup, 2007; Yildirim & Yildirim, 2009; Tezci, 2011). Because technology integration is a complex process, it is necessary to discuss the set of common ICT barriers identified in the literature. Although most researchers define, label and measure these obstacles in varying ways, they agree that the widespread barriers are lack of access, poor

software quality, insufficient support and low self-confidence (Schoepp, 2005). Ertmer (1999) classifies ICT barriers into two main categories: 1) extrinsic or first-order barriers such as not having the computers, quality software, and sufficient time to acquire ICT knowledge and skills, and 2) intrinsic barriers or second-order barriers which refer to teacher attitudes, beliefs or assumptions. Balanskat et al., (2006) divides ICT barriers into micro-level barriers, including factors such as educators' attitudes and beliefs, and meso-level barriers, including factors that are related to the school or educational institution such as the absence of sufficient ICT resources or adequate maintenance. The third category which applies to macro-level barriers which focuses on regulations and evaluation methods, which "do not take into account new competencies acquired by using ICT in learning" (Balanskat et al., 2006: 58). Balanskat et al. (2006) note that most educators consider system-level barriers to be a crucial hindrance in teaching and learning. Daly et al. (2009) divide ICT barriers into education-level barriers and school- or institution-level barriers. All factors that relate to the teacher such as lack of time or self-confidence are considered to be education-level barriers, whereas factors which refer to the institution, such as lack of support or access to computers, are considered to be school-level barriers (Bingimlas, 2009). Since most of these studies divide ICT barriers into two categories which refer to the individual and to the system (Bingimlas, 2009), theoretical knowledge from this twofold classification contributes to the present study of factors which promote or inhibit teacher educators' CTPD.

As discussed above there is a reasonable amount of research that focuses on barriers to emerging technologies-use in general, however, there are only a few studies that look at the factors and barriers concerning teacher educators' CTPD (Becta, 2004; Bingimlas, 2009). In response to this need, this research focusses on the factors and barriers that inhibit or contribute to teacher educators' CTPD trajectories. The analysis of data in this research will bring together the findings and key points that not only contribute to a more profound understanding of perceived barriers in teacher educators' CTPD trajectories, It will also serve to design and develop a TLP-instrument which supports teacher educators technology learning.

2.6 Concepts of workplace learning and teacher educators' CTPD

This research on technology learning in the workplace is particularly concerned with individual teacher education i.e. teacher educators' personal technology professional development. However, Opfer and Pedder (2010, 2013) argue that teacher educators' learning cannot be separated from the environment in which it takes place because the teacher educator and his or her practice have an input on the learning. Examining what technology learning in the workplace constitutes contributes to a better understanding of CTPD in the workplace.

Workplace learning has gained more importance over the past two decades as schools, colleges and educational institutions in general have become more aware of providing teacher educators with adequate CTPD programmes (King, 2002; Baylor & Ritchie, 2002; Gorder, 2008; Crawford-Ferre & Wiest, 2012), although workplace learning is most often described in the literature as being formal learning (Hargreaves & Finke, 2000; Colley et al., 2002; Stentröm, 2006; Tynjälä, et al., 2006; Tynjälä, 2008; Anderson & Dron, 2011). Technology learning in the workplace is therefore "becoming the new frontier for the next-generation learning environment" (Collins & Halverson, 2009: 71), which is a key focus in this research. Since the 1990s, interest in workplace learning has increased and more studies have been conducted in this area. One of the reasons for this interest is that changes in society and working life have occurred due to economic, social and cultural factors (Tynjälä, 2008). Other reasons are the unprecedented, rapid development of ICT (Merriam et al., 2007; Sloep & Jochems, 2007), the increasing production and exchange of knowledge in a network society and globalisation, which have all presented new challenges to the way work is performed, not only in business but also in the education sector (Field, 2006; Merriam et al., 2007; Tynjälä, 2008). Because of these changes in work and society, it is important "to develop new ways of ensuring that the level of competence of the workforce meets these challenges" (Tynjälä, 2008: 131). Continuing learning is important to all individuals, which was a concern of the Commission of European Communities' 1995 (CEC: 6):

> "Education and training will increasingly become the main vehicles for self-awareness, belonging, advancement, and self-fulfilment. Education and training whether acquired in the formal education system, on the job or in a more informal way, is the key for everyone to controlling their future and their development."

Studies (Hargreaves & Finke, 2000; Stentröm, 2006; Tynjälä, et al., 2006; Anderson & Dron, 2011) on the outcomes of traditional education have indicated "that there is a gap between" what learners need to know to do their jobs "and the knowledge and skills produced through formal education" (Tynjälä, 2008: 131). Richardson and Placier (2001) note in their review on teacher learning that the body of literature can be divided into two groups: research that focusses on individual teacher learning and research that focusses on the school as a learning context. Richardson and Placier (2001: 937) state that these two areas of research "largely stand on their own ─ almost entirely uninformed by each other". Although there is agreement about the importance of workplace learning (Clarke, 2005; Lohman, 2005; Siadaty et al., 2012), Richardson and Placier (2001) argue that there is no general consensus on what constitutes workplace learning. Researchers such as Billett (2002) define workplace learning as directly guided or indirectly guided on-the-job activities that contribute to the development of knowledge and skills which are required for productive work practices. Matthews (1999: 19) states that "any definition of workplace learning will potentially be constrained by the perception held of the 'workplace'". The constraint is based on the fact that several researchers "view the workplace as a physical location" (Matthews, 1999: 19). In addition, Holliday and Retallick (1995: 7 as cited in Matthews, 1999: 19) state that:

> "Workplace learning refers to the processes and outcomes of learning that individual employees and groups of employees undertake under the auspices of a particular workplace."

Rylatt (1994: 10) defines workplace learning as "a sustained and high leverage development of employees in line with organisational business outcomes". Although "each of these definitions assumes that learning is necessary for the individual and the organisational development" (Matthews, 1999: 19), none of them encompass the broader context of workplace learning which focuses on the individual learning needs. My view of workplace learning is considerably broader, but it is in agreement with Matthews' (1999) view. Learners can acquire knowledge and skills in different locations through interpersonal and contextual influences. "By integrating key issues of existing definitions, it is possible to develop a workplace definition which is

applicable" in the context of teacher educators' learning (Matthews, 1999: 19). Some key characteristics which have been defined based on Matthews' (1999) review of the literature on workplace learning and Billett's (2002, 2004) research have been adapted to the current research context. These characteristics include the learning context, meaningful or needs-based learning, learning processes, sustained development of knowledge and skills, and personal and interpersonal learning of teacher educators. A "working definition of workplace learning that will underpin the argument" (Matthews, 1999: 19) in the context of this research is the following: Workplace learning is the process that learners use when they engage in various preferred ways of learning and related activities for the purpose of acquiring new technology knowledge and skills that apply to the individual technology learning issues and concerns. The emphasis in this definition is on the *preferred ways of learning and related activities* because learning should cater to individual preferences.

As noted earlier, teacher educators encounter constant pressure to improve and innovate in order to perform to the highest standards and provide students with the best learning opportunities (Darling-Hammond et al., 2009). Yet, traditional CTPD programmes are often inadequate to promote teacher educators' CTPD (Clarke & Hollingsworth, 2002). Many CTPD programmes are disconnected from teacher educators' practice. For technology learning in particular, traditional offsite CTPD programmes are often decontextualised workshops or courses. Due to the development and innovation of emerging technologies, teacher educators' ICT knowledge and skills become rapidly outdated. Most CTPD programmes are designed and developed according to a generic, one-size-fits-all concept that attempts to add new pedagogical perspectives on ICT use to older ones. Instead, teacher educators should be provided with meaningful learning opportunities that connect to the educator's workplace and allow teacher educators to transform their teaching based on new ideas, conceptions and personal learning needs (Ashburn & Floden 2006; Lawless & Pellegrino, 2007; Timperley et al., 2008; Herrington et al., 2014).

Teacher educators' workplace learning involves structured and unstructured learning activities which in the context of this research both contribute to the development of new technology knowledge and skills required for productive educational practice (Billett, 2002). Workplace learning is formal and informal, and both are the focus of this research. Informal

learning, which involves learning choices and activities that are initiated by the teacher educator as a learner, “lacks systematic support explicitly organised to foster teacher learning” (Marsick, 2009: 268). In this study, the purposes of teacher educators’ technology learning are to improve their own work practices and collective performances in educational contexts.

The discussion of workplace learning illustrates the complexity and breadth of this concept, and the variety of meanings and definitions which are attached to its use in several working contexts. From the discussion it is clear that technology learning in the workplace comprises a wide range of professional development learning activities which can be planned, formal ways of learning or based on informal ways of learning. As this research focusses on the process of designing and developing an instrument that might support teacher educators’ technology learning in the workplace, examining more in depth different ways of workplace learning is essential in the design of a TLP-instrument.

The next section examines literature around formal and informal learning processes within teacher educators’ workplace learning in more detail.

2.7 Teacher educators’ formal and informal learning

Whenever people are asked about their learning, most will mention classroom or school settings in which teachers provided them with the necessary knowledge and skills based on pre-set, curriculum-driven learning outcomes. Most people picture a classroom situation in which the teacher is at the centre of the learning process since he/she knows what is good for his/her students. But when asked what they have learned over the years, most people will admit that new knowledge and skills were acquired outside of these formal settings (Kwakman, 2003; Kools et al., 2012). In considering the spectrum of technology learning opportunities for teacher educators, it is therefore important to acknowledge not only formal learning but also informal learning opportunities.

A pressing question in the context of this research is the following: Why is it important that educators, curriculum developers and policymakers recognise that technology learning occurs in formal and informal learning contexts? The upsurge of interest has already been noted in the CEC’s white paper (1994: 136), which stated that:

> "Preparation of tomorrow's world cannot be satisfied by a once-and-for-all acquisition of knowledge and know-how … All measures must therefore necessarily be based on the concept of developing, generalising and systematising lifelong learning and continuing training."

As discussed earlier, lifelong learning is expected of professionals across all professions and "a one-off dose of school and college will not serve to get you through life's many challenges and opportunities" (Field, 2006: 1). In his foreword to the 1998 white paper on lifelong learning, the then UK Secretary of State and Employment, David Blunkett, wrote that fostering an enquiring approach to learning is essential for the development of the skills and competencies that are needed in a Knowledge-based society:

> "To cope with rapid change and the challenge of the information and communication age, we must ensure that people can return to learning throughout their lives. We cannot rely on a small elite, no matter how highly educated or highly paid. Instead we need the creativity, enterprise and scholarship of all our people. As well as securing our economic future, learning has a wider contribution." (DfEE, 1998: 7)

Given the pace of change and readjustment in education and the constant demand for flexibility and performance improvement, an increase in informal and self-directed learning has occurred, sparked by the tensions that teacher educators experience as a result of the transformations that they encounter in their daily practices (Billett, 2002; Lohman, 2006).

Over the last decade, formal and informal learning contexts and their added value in the workplace have been endorsed by many researchers (Cofer, 2000; Billett, 2002; Lohman, 2006; Tynjälä, 2008, Meirink et al., 2009). Many (Colley et al., 2002; Folkestad, 2006; Cross, 2007; Huebner, 2009; Chambers, 2009) agree that learning occurs along a continuum which ranges from a formal to an informal learning context "rather than either-or dichotomies" (Dabbagh & Kitsantas, 2011: 2). Within the context of this research, both learning strategies can be regarded as complementary for teacher educators' CTPD in the workplace.

Increasingly, organisations have been questioning traditional learning approaches which are designed to produce knowledge and skills for the job. Dale and Bell (1999) identified the benefits of a non-traditional or informal approach to workplace learning, including increasing the flexibility and employability of employees, adapting the professional development to learners' needs, and fostering learning to become more integrated through contextual and social influences (Smith, 2008). Dale and Bell (1999) also identified drawbacks when workplace learning relies solely on informal learning, namely, the lack of transferability based on the learners' narrow contextual focus, and the fact that the learning is so well-integrated into the learners' work that the learner may not recognise it. Taking into consideration that there are several ways of learning, the design and development of a TLP-instrument should focus on the various preferred ways of learning which might support teacher educators in mapping their learning preferences.

2.7.1 Formal and informal learning in the workplace to support teacher educators' CTPD

Recently, interest has increased among researchers (Lohman, 2006; Hoekstra et al., 2007; Tynjälä, 2008; Bolhuis et al., 2010), policymakers and teacher education institutions in how teacher learning in the workplace should be organised and facilitated. Although there is a general consensus that traditional, formal CTPD programmes have many limitations (Schrum, 1999; Holland, 2001; King, 2002; Kirschner & Selinger, 2003; Kwakman 2003; Glasser & Schrum, 2009; Hassler et al., 2011), most alternative programmes depend on the kind of theoretical stance or perspective taken (Kwakman, 2003).

The literature consulted for this study reveals many similarities and dissimilarities regarding formal and informal learning. As stated in the previous section, defining formal and informal learning is challenging, which Colley et al. (2002: 5) confirm:

> "Many texts use one or more terms without any clear definition. In an arguably even larger number, issues involved are either assumed or addressed, but without the explicit use of terms at all. A smaller, but still considerable and growing body of writing, sets out definitions of one or more of the terms concerned. … [T]here is little agreement about

how these terms should be defined, bounded or used. There is often considerable overlap, but also considerable disagreement."

One of the problems in defining formal and informal learning is that in many different discourses informal learning is defined by what is not formal (Tynjälä, 2008). "Eraut's (2000) as cited in Colley et al., 201) classification of learning" (Colley et al., 2002: 12) focusses on formal learning by referring to five features: "1) a prescribed learning framework, 2) an organised learning event or package, 3) the presence of a designated teacher, 4) the award of a qualification or credit, and 5) the external specification of outcomes" (Eraut, 2000 as cited in Colley et al., 2002: p.12). Although Eraut's (2000) classification is limited to five key features, it is a useful start to address the issues concerning formal and informal learning. The preliminary research phase in this research will further explore teacher educators' formal and informal ways of technology learning in order to gain a more profound understanding with regard to teacher educators' formal and informal ways of preferred learning. The five key features of formal learning as discussed above have therefore been chosen to be useful since learning what is not based on these five key features might be regarded as informal learning.

Research carried out by Jarvis (2006) and Darling-Hammond (2009), shows that teachers learn from examining experiences and collaborating with other colleagues (Levine, 2007; Scribner et al., 2007; Kolis, 2013), and from deliberate practice activities (Ericsson, 2006; Hattie, 2012). Despite the lack of a substantial body of research on what makes CTPD programmes effective, traditional CTPD programmes still "focus on delivering content rather than enhancing learning" (Webster-Wright, 2008: 702), and their format is often mandatory workshops or trainings. Based on their studies of workplace learning (Eraut, 2004, 2008; Bancheva & Ivanova, 2015), argue that formal or traditional learning activities account for a small part of what is learned in the workplace since most content is learned informally.

Teacher educators' workplace learning has been studied in terms of the key concepts of formal and informal learning, which several researchers have conceptualised as a dichotomy (Marsick and Watkins, 2001). Researchers (Kwakman, 2003; Eraut, 2004; Tynjälä, 2008; Bolhuis, 2009; Frietman et al., 2010) argue that workplace learning can be characterised by learning processes which are mostly "unintentional" and "unplanned", occurring as part of teacher educators' daily activities (Tynjälä, 2008: 133). Informal learning refers to a more

natural way of learning, in which teacher educators acquire ICT knowledge and skills more spontaneously (Schrum, 2009; Bancheva & Ivanova, 2015). According to Marsick (2009), informal learning often occurs through experiences. Informal learning has an autonomous, independent and self-directed nature. A question that arises from the literature on formal and informal learning is whether teacher educators have specific learning preferences regarding their CTPD. Based on the insights from the literature review on formal and informal learning, the different characteristics and operational descriptions inform the design of the TLP-instrument which might support mapping teacher educators' formal and informal learning preferences.

2.8 Teacher educators' individual and collective learning

The promotion of collaboration and learning in the workplace has been a high priority in the reform efforts of teacher education institutions for the past few decades. Several studies have shown that teacher educators' collaboration involves a process of accomplishing shared learning goals which are considered valuable in fostering technology learning in the workplace (Cordingley et al., 2005; Stahl, 2006; Levine & Marcus, 2010). In this section, collective and individual learning are introduced and explored as different ways of learning that fit into current views on workplace learning. In examing the literature on individual and collective learning, insights form the literature can be used to design and develop the TLP-instrument using collective and individual technology learning aspects to map teacher educators' learning preferences.

As discussed earlier, the literature has traditionally focussed on the concept of learning in terms of formal and informal education (Eraut, 2004; Field, 2006; Tynjälä, 2008, Siemens, 2014). Yet, teacher educators' workplace learning also involves individual and collective learning processes. Learning can be characterised as an individual process of consuming and storing new concepts and skills (Nafukho et al., 2004; as cited in Fenwick, 2008). The different kinds of activities that teacher educators engage in during their teaching practices will influence what and how they learn (Garet et al., 2001; Kwakman, 2003). Billet (2001, 2004) states that different kinds of workplace tasks are likely to result in particular kinds of learning. Therefore, learning that is limited to only formal learning activities influences the transfer of technology knowledge and skills across different educational contexts, "which helps to explain limits of

transferability of learning in classroom-like activities to non-classroom-like activities" (Billet, 2001: 33). In this research the concept of learning in the workplace will therefore not be limited to formal and informal learning methods, but will include individual and collective learning methods.

Paavola et al. (2004) view learning as the creation of new concepts, ideas, understandings and knowledge. Although learning is considered to be a social process (Sfard, 1998), Paavola et al. (2004) consider the main aim of participation to be the development of new knowledge and skills in existing teaching and learning practices, rather than to socialise learners in their learning context. Learning can therefore be considered as an integration of cognitive and social aspects. However, learning needs to be relevant to the teacher educators' practice. Studies by Schön (1983), Polland (2005), and Day et al., (2005) emphasise the importance of reflecting on and embedding new knowledge and skills in teacher educators' practice as necessary aspects for effective learning and professionalization opportunities.

A significant focus within the literature related to professional development in the workplace is on the value of collective learning and communities of learning. Workplace learning is not only confined to an individual way of learning but quite often occurs "in the learning of *groups*, the learning of *communities*, the learning of organisations" (Tynjälä, 2008: 132). Several researchers have observed that learning is situated within the context of authentic, everyday activities in which joint participation within the group of learners provides several learning opportunities for both novices and experts (Lieberman & Miller, 1999; Herrington & Oliver, 2000; Herrington & Herrington, 2007). As the focus of this research is on teacher educators' preferred ways of technology learning, examining more in depth in what way collective learning might contribute to individual professionalisation trajectories may add to a better understanding of the importance of acquiring ICT knowledge and skills within professional learning communities or groups.

A professional learning community can form within the workplace a means to share experiences, views, knowledge, and skills and can be used to promote collaboration among teacher educators. One goal of a professional learning community is to foster group interaction in order to acquire new technology knowledge and skills. Wenger (1998: 19) defines these communities of practice as "groups of people who share a concern or passion for something

they do and learn how to do it better as they interact regularly". In line with Wenger's definition, McDermott (2001: 4) defines a community as "a group of learners, who share knowledge and learn together, and create common practice". Andrew et al. (2008: 246) describes these communities of learners "as an innovative way for educators and practitioners to collaborate to develop and manage new knowledge and emerging practice". Lave and Wenger (1991), Wenger (1998) and Wenger et al. (2002) promote these communities of practice for collective learning "as a gateway to informal professional learning, suggesting that [when these communities] are embedded in the workplace, they can create an identity for and give meaning [to teacher educators' teaching] practice" Andrew et al., 2008: 7). Andrew et al. (2008), Wenger (1998) and Wenger et al. (2002) suggest that collective learning within a learning community can assist in understanding complex professional issues such as technology learning, and these communities can "provide micro-level responses to work-related problems; they complement and substitute for formal learning mechanisms" (Andrew et al., 2008: 7-8). In this research it would be interesting to investigate what support these communities can provide in teacher educators' technology learning processes. Do they provide a common forum to articulate and develop their learning or are they a distraction? Wenger et al. (2002) claim that a collective learning process becomes reified when the learners in a group or community can give the process a form and use it in their reflection. Participation and reification enhance meaning within the group. Investigating in what ways participation and reification influence the learning of new ICT knowledge and skills is quintessential in investigating the use of collective learning in this research. Wenger (2003) and McDermott (2001) state that reification can only occur when the learners actively participate together, which means that the relationship between participation and reification is one of duality. Participation and reification are therefore essential ingredients of teacher educators' collective learning in the workplace. For this research, insights into collective and individual learning are useful in teacher educators' preferring ways of learning. The insights of the literature review will contribute to the separate design-based research phases that inform the design of a TLP-instrument which might support teacher educators' CTPD trajectories.

As noted earlier teacher educators'' technology learning in relation to their CTPD suggests that teacher educators feel that professional development programs focus more on

school or national reform issues rather than their own personal technology development needs. Decisions on a managerial level, which focuses in most cases on school issues such as improvement and control might restrict teacher educators' technology learning. Focussing more on collective learning aspects might enable teacher educators to be more actively involved in their CTPD trajectories.

As highlighted above, working together is a strong element in professional development processes, and the evidence is that collective learning might contribute to teacher educators' technology learning. As Research Questions 1 and 2 focuses on the investigation of teacher educators' preferred ways of technology learning and related learning activities, the theoretical insights about collective and individual learning might not only contribute to the design and development of a TLP-instrument, but they might also contribute to a better understanding of educators' technology learning in the workplace.

2.9 Summary and conclusion

This chapter has attempted to clarify the interdependent nature of learning and working. Teacher educators' work practices structure learning activities in several ways that influence their technology learning. The types of learning activities which teacher educators engage in are central to learning the required knowledge and skills that are related to their teaching practices. The knowledge constructed in the workplace is likely to be different from that learned through traditional approaches, in the sense that workplace learning is not limited to only formal approaches. The learning activities that teacher educators engage in, and the kind of support and guidance that they are provided, are multifaceted and central to the workplace itself. The key concern is that workplace learning is directed towards developing technology knowledge and skills that are purposeful and meaningful to the learner.

The various insights based on exploring and examining the literature on workplace learning have provided interesting starting points related to Research Questions 1, 2 and 3 which need to be further explored during the research process. Additionally, the theoretical insights concerning formal and informal, and individual and collective learning in the workplace provide a basis for the preliminary research phase to further explore and examine technology learning aspects that are useful for the design and development of a TLP-instrument. The next

chapter will focus on the methodological decisions made in the process of designing the TLP-instrument.

Chapter 3:
Research methodology

3.1 Introduction

This chapter discusses the theoretical background with regard to the methodological choices made for the research design, which will inform the data collection, analysis and development of theory. This chapter develops a basis for the philosophical research stance and ethical considerations by drawing upon a thorough literature review and the researcher's personal views on research paradigms. The research adheres to a design-based research approach informed by grounded theory and employs mixed methods (Wademan, 2005; Reeves, 2006). The chapter discusses the data collection phases for this research, which consist of a web-based questionnaire, semi-structured interviews and reflective reports. The chapter concludes by explicating the approach to analysing the collected data.

3.2 Brief summary of purpose

As discussed in Chapter 1, the purpose of this research is to respond to the scarcity of research on teacher educators' technology learning in the workplace, with a particular emphasis on their preferred learning approaches. In this research, a theoretical framework has been used to inform the design and development of a TLP-instrument. A design-based research approach was used to construct, develop, evaluate and refine consecutive prototypes of the TLP-instrument to make the design more robust. Because one purpose of the research is to investigate how the instrument can support teacher educators' technology learning in the workplace, investigating the use of the instrument might contribute to a better understanding of technology learning processes.

3.3 Epistemological stance: Constructionism

The approach adopted in this research is closely related to social epistemology because the research will be examining the teacher educators' technology learning and their understanding of knowledge within the social context. The perspective of knowledge which underpins this research is a constructivist viewpoint. Constructionism claims "that meanings are constructed by human beings as they engage with the world they are interpreting" (Crotty, 1998: 43).

The methodological choices relate to the aims and questions posed in the research. The justification involves "identifying the underlying assumptions about reality and understandings of the world and its phenomena" (Crotty, 1998: 43). The chosen philosophical stance both underpins the theoretical perspective and determines the methodology and methods which underpin this research (Crotty, 1998). One can derive a dominant perspective which is appropriate for the purpose of the research, although "few pieces of research are ever 'pure' examples of any one paradigm, fitting unequivocally into one category to the exclusion of the other" (Candy, 1989: 8). In identifying the theoretical framework concerning the current research, a schema (Figure 3.1) has been developed based on Crotty's (1998) four elements of any research process: epistemologies, theoretical perspectives, methodologies and methods.

Figure 3.1 *Schema theoretical framework of the research*[1]

Epistemology	**Theoretical perspective**	**Methodology**	**Methods**
Social constructionism	Interpretivism	Design-Based research Informed by Grounded Theory	• Questionnaire • Descriptive statistics • Semi-structured interviews • Reflective reports • Data reduction

In many research articles, epistemology is defined as a philosophical term meaning theory of knowledge (Browaeys, 2004), but there is "little consensus on what the term 'knowledge' comprehends" (Goldman, 2010: 1) or what the research purpose should be in relation to knowledge. Epistemology and theory of knowledge are terms that are quite frequently used interchangeably and are concerned with the analysis of what is meant by the term knowledge,

[1]Adapted and devised from Crotty, M. (1998) *The foundations of social research*. London: Sage Publications, p. 5

its reliability, “what kinds of knowledge are possible and how we can ensure that they are both adequate and legitimate” (Maynard, 1994: 10). According to Hamlyn (1995: 242), epistemology studies “the nature of knowledge its possibility, scope and general basis”. Maynard (1994: 10) states that “epistemology is concerned with providing a philosophical grounding for what kinds of knowledge are possible and how we can ensure that they are both adequate and legitimate”. Maynard (1994) emphasises the need to identify, explain, and justify the epistemological stance that one adopts as a researcher. An epistemology “is a way of understanding and explaining how we know what we know” that informs “the theoretical perspective”, in turn informing the research methodology that “provides a context” for the logical choices and criteria in doing research (Crotty, 1998: 8).

Because this research aims to gain more insight into teacher educators’ formal and informal learning situations and their individual and collective learning in the workplace to design and develop the TLP-instrument, it is appropriate to embed the research in the epistemology of social constructionism.

Constructionism is far removed from the objectivism found in a positivist stance (Crotty, 1998). Although constructionism and constructivism are often used almost interchangeably (Burr, 2003), several researchers make a distinction between the two terms (Papert, 1990; Burr, 2003; Talja et al., 2005; Gergen, 2009). For instance, Papert (1990: 3) states that:

> “The word with the v expresses the theory that knowledge is built by the learners … The word with the n expresses the further idea that this happens especially felicitously when the learner is engaged in the construction of something external or at least sharable.”

Constructivists regard learning as an internal mental process through which the learner constructs meaning or truth by processing and constructing knowledge and by comparing and analysing this with previously acquired experiences and knowledge (Von Glasersfeld, 1990; Kukla, 2000; Rockmore, 2008). The construction of knowledge and reality “is made up of the network of things and relationships that we rely on in our living, and on which, we believe, others rely on, too” (Von Glasersfeld, 1995: 7). According to this view, each person creates his or her own world of phenomena and therefore his or her own reality. Von Glasersfeld (1984: 24), whose thinking and theories are profoundly influenced by Piaget’s research, emphasises

that “knowledge does not reflect an objective, ontological reality but exclusively an ordering and organization of a world constituted by our experience". This means that the knower interprets, analyses and draws conclusions to construct a reality that is based on experiences.

In contrast, social constructionism sees the construction of information or knowledge as an external process or a manifestation of the constructivist internal mental process. In other words, the learner constructs new information or knowledge based on the interplay with the direct social environment. Social constructionists (Danziger, 1997; Crossley, 2000; Sabelli, 2008) reject the idea of knowledge being a direct perception of reality and state that “there can be no such thing as an objective truth” (Burr, 2003: 6), or as Crotty (1998: 8) states, “truth, or meaning, comes into existence in and out of [our] engagement with the realities in [our] world”. Meaning is therefore not created, but constructed based on the interconnectedness of objectivity and subjectivity. This view is in line with Denzin and Lincoln (2000) and Charon (2001), who state that one’s concept of reality is constructed as a result of the engagement with objects, events, thoughts, perspectives and the way one responds to them. Social constructionism invites the researcher to reject the notion that there is truth and objective knowledge about the world and “social constructionism insists that we take a critical stance toward our taken-for-granted ways of understanding the world” (Burr, 2003: 2). “Social constructionism is therefore in opposition to what” philosophers and social scientists regard “as positivism and empiricism” following the social empiricist tradition of conducting research, that is, “the assumption that phenomena can be revealed” by observation and reason to find universal laws (Burr, 2003: 3). Social constructionism alerts the researcher to be suspicious of assumptions about how the world and phenomena appear to be and asks the researcher to be aware that phenomena related to human behaviour are not black or white but grey.

In the context of teacher educators’ technology professionalisation, the construction of knowledge or meaning is a dynamic ongoing, daily process since the educators are not passive recipients of knowledge but are actively involved in the construction of new technology knowledge and skills. In this research, teacher educators and the researcher will both construct meaning based on a social interaction that underpins the significance of individual perspectives in constructing reality (Seale, 1999; Gephart, 2004; Lincoln et al., 2011).

Social constructionism as outlined above focusses on social interaction as the means of constructing knowledge. Understanding teacher educators' individual learning values and beliefs is crucial to understanding the factors which influence their CTPD. In this research, social constructionism can therefore be regarded as a suitable epistemology based on two assumptions: 1) It sees teacher educators as agents in control of their technology learning process and the construction of technology knowledge and skills in a learning process that is based on interaction with their environment. 2) It sees the researcher as the agent who is in control of gaining insight into teacher educators' technology learning and constructing knowledge to design and develop a TLP-instrument to support educators' technology professionalisation.

In conclusion, constructionists view knowledge construction as dependent on the interactions of humans with their environment, and thus social constructionism as an epistemology best serves the research purpose in the given context. To gain more insights into factors in formal and informal learning contexts that influence teacher educators' technology learning preferences and the construction of knowledge that can contribute to the design and development of a TLP-instrument, constructionism as an epistemological view underpins the interpretivist stance taken in this research.

3.4 Theoretical perspective: Interpretivism

In the schema (Figure 3.1) presented in the introduction of this chapter, the second column focusses on the theoretical perspective embedded in the research methodologies. This section describes the rationale for the theoretical perspective that underpins the chosen methodology to explain how this perspective provides a context for designing the research, and which assumptions have been made to arrive at the chosen methodology.

Interpretive research tries to get a better understanding of a phenomenon from the perspective of those experiencing it (Crotty, 1998). Interpretivism has its background in phenomenological and constructivist thought (Blaikie, 1993). People create meanings when they engage with the world they are interpreting, based on their own experiences, views, thoughts and backgrounds (Schwandt, 2005: 40):

> "The interpretivist believes that to understand this world or meaning one must interpret it. The inquirer must elucidate the process of meaning construction and clarify what and how meanings are embodied in the language and actions of social actors. To prepare an interpretation is itself to construct a reading of those meanings."

Different ways of revealing meaning can highlight aspects of teacher educators' technology learning. This research intends to explore with the research participants their preferences for technology learning and activities and how technology learning fits within the context of their teaching practice. This involves the researcher constructing a reading of the meaning the participants have given to their experiences of CTPD and professional learning (Schwandt, 2005).

An elaboration of the theoretical perspective "is a statement of the assumptions brought to the research task and reflected in the methodology as we understand and employ it" (Crotty, 1998: 7). For example, in this research, grounded theory has been chosen as the strategy or plan of action and semi-structured interviews will be used for data collection, but the question remains, "what assumptions are embedded in this way of proceeding?" (Crotty, 1998: 7). In conducting semi-structured interviews, some of the assumptions relate to matters concerning communication (verbal and nonverbal) and issues of intersubjectivity (the researcher in communication with research participants) (Crotty, 1998: 7). Gaining insights into teacher educators' technology learning and constructing meanings and knowledge based on those insights reflects and justifies the epistemological choice as described earlier. This justification also underpins the methodological choices and the selected data collection and analysis methods. Expounding on the theoretical stance taken in this research context serves as a justification of a particular view of the human world and the social interactions of the research participants within that world, wherein the given assumptions are grounded (Crotty, 1998).

From an interpretivist perspective, theory is emergent and arises from different situations and "should be grounded in data" (Glaser & Straus, 1967 as cited in Cohen et al., 2011: 18). The aim of this research is to gain insight into factors which influence teacher educators' technology learning in order to construct theory and understanding. An additional goal is to understand the reality of teacher educators' technology learning by making efforts to

"get inside" participants' experiences and to understand from within, as a means of contributing to new theory and understanding. There is resonance here with a grounded theory approach since it "is an inductive, theory discovery methodology that allows the researcher to develop a theoretical account of the general features of a topic while simultaneously grounding the account in empirical observations or data" (Martin & Turner, 1986: 141).

3.5 Rationale for choosing grounded theory and design-based research approaches

Two different research methodologies were selected for the design of this study. These complementary approaches, grounded theory and design-based research, were selected based on their ability to make practical and theoretical contributions to the issues under investigation. The theoretically-based grounded theory approach contributes to the fundamental understanding of teacher educators' technology learning in the workplace, while the practical, design-based method contributes primarily to the applied use of an instrument designed to support teacher educators' technology learning in the workplace.

Design-based research and developing the instrument intended to make a practical contribution takes time, and the problems to be addressed in the design and implementation processes are identified and explored through an iterative process that involves gathering insights from both the literature, as discussed in Chapter 2, and the field in which the interventions are conducted. "The design process" is not done in one fell swoop, as the designs of the prototype instrument "need to be tuned and optimized to" yield best results (Akker et al., 2006: 11).

A grounded theory approach is a useful complement to the design-based strategy, as it enables examination of the data collected during the cyclic iterations of design and thereby facilitates understanding and improving the prototype instruments during the research process. Additionally, a grounded theory approach will enable the researcher to construct and/or further elaborate upon emerging theoretical understandings concerning teacher educators' technology professionalization. These understandings may contribute to the development of new insights as well as conceptualisations applicable in other educational contexts (Van den Akker et al., 2006).

The following sections discuss both research methodologies more in detail and elaborate on the practical and theoretical contributions each method is expected to make throughout the research process.

3.6 Grounded theory as a qualitative research methodology

As the focus of this research is to explore and understand teacher educators' technology learning preferences in the workplace, grounded theory as a research methodology is in agreement with the theoretical framework of the research (see Figure 3.1). Grounded theory "comprises a systematic, inductive, and comparative approach" (Bryant & Charmaz, 2007: 1) for conducting qualitative inquiry to construct theory during the research process (Charmaz, 2006; Charmaz & Henwood, 2007). According to Thornberg (2012: 85), grounded theory "is a qualitative and inductive research approach which is designed to explore, analyse and generate concepts about individual and collective actions and social processes". Thornberg's definition matches the epistemological stance as discussed in Section 3.4 and the choice of grounded theory, since social constructionism focusses on knowledge construction that is dependent on the interaction of humans with their environment. In the given context of teacher educators' individual and collective technology learning activities and the related social processes, grounded theory offers the researcher flexible and systematic guidelines to examine possible explanations for the theoretical findings (Bryant & Charmaz, 2007; Thornberg, 2012).

Although there are different interpretations of grounded theory, most theorists working in the area underscore the fact that data shapes the research process and product based on multiple iterations of investigation (Glaser & Strauss, 1967; Strauss, 1987; Strauss & Corbin, 1990; Crabtree & Miller, 1999; Hesse-Biber & Leary, 2006; Charmaz, 2009). The collection and analysis of data work in tandem throughout the research process (Glaser, 1998; Strauss & Corbin, 1998; Bryant & Charmaz, 2009; Thornberg, 2012). Grounded theory allows for using "data that is grounded to be identified, discarded, clarified and elaborated upon (relative to that situation) through simultaneous data collection and analysis" (Waring, 2012: 299). Hesse-Biber (2007: 320) states that there is an iterative relationship between "data collection, data analysis and theory generation". This "analytical induction" (Hesse-Biber, 2007: 320) based on a cyclical approach helps the researcher to engage in an ongoing process of reflexive analysis. This

iterative process of data collection and analysis fits with the chosen design-based research approach in which the cyclical process of data generation and analysis informs the refinement of the TLP-instrument prototypes. From this process, insights will emerge that can be considered as building blocks of theory that will address the research questions and create a greater understanding of preferred technology professionalisation as it occurs in the teacher educators' educational practice (Akker et al., 2006).

Grounded theorists use different data collection methods as appropriate for the research questions and the way in which the data is analysed. Frequently used methods for data collection are interviews, observations and reflective reports (Glaser & Holton, 2007). Different kinds of data offer the researcher distinct views or vantage points from which to understand teacher educators' technology learning.

The starting point in this research is not a theory, but the four research questions discussed in Chapter 1. Exploring the issue of teacher educators' technology learning in the workplace is a complex process. Using different data collection methods supports the exploration of such complexity in the research, which is informed by a grounded theory approach. Collecting data from the web-based questionnaire during the preliminary design-based research phase will yield new ideas and inputs for the design of the semi-structured interviews during the prototyping phases of the TLP-instrument. During each design-based research phase, the analysis of data provides new insights, ideas, experiences or questions about preferred technology learning methods and activities, which might lead to changes in the data collection methods. This interplay between data collection and analysis is essential in grounded theory and is called theoretical sampling, which supports the development of theory during the iterative investigation.

3.7 Design of the research process

This section is divided into three parts. The first part provides an introduction to conducting design-based research in educational contexts. After a definition and a brief description of design-based research, the second part focusses on its main characteristics. The third part focusses on the process of design research with its three core phases. Additionally, a model for conducting research about teacher educators' technology professionalisation is presented

which portrays the overall research process. All three parts include a justification for the reasons for choosing a design-based approach in the current research.

Design-based research is commonly used as a term "for many related research approaches" (Van den Akker et al., 2006: 7) such as design experiments and developmental or formative research, and it should be noted that these terms are used interchangeably in many studies (Brown, 1992; Collins, 1992; Richey & Nelson, 1996; Gravemeijer, 1998; Kelly, 2003, 2004; Richey et al., 2004; McKenney et al., 2006; Schoenfeld, 2006; Walker, 2006; Reinking & Bradley, 2008; Kali & Ronen-Fuhrmann, 2011). Despite the lack of consensus on the definitions and terminology of design-based research, Barab & Squire's (2004: 2) definition seems to encompass most aspects that apply to design-based research in educational contexts: a "series of approaches, with the intent of producing new theories, artefacts and practices that account for and potentially impact learning and teaching in naturalistic setting[s]". Design-based research aims to develop research-based solutions for complex educational problems in practice. According to Plomp & Nieveen (2010: 13), design-based research is:

> "The systematic study of designing, developing and evaluating educational interventions (such as programmes, teaching-learning strategies and materials, products and systems) as solutions for complex problems in educational practice, which aims at advancing our knowledge about the characteristics of these interventions and the processes of designing and developing them."

What distinguishes design-based research in an educational context from other forms of research is that "the design is conceived not just to meet local needs, but to advance a theoretical agenda, to uncover, explore, and confirm theoretical relationships" (Barab & Squire, 2004: 5). Van den Akker et al. (2006) argue that the first and most convincing motive for conducting design-based research originates in the desire to enhance the significance of doing research in educational contexts through offering suggestions to improve educational policy and practice. Because design-based research is conducted in target settings such as school classrooms, online learning communities or other places where learning occurs, both researchers and practitioners can design, develop and construct relevant and workable solutions to complex educational problems.

The iterative approach, in which constructed theory based on the insight into teacher educators' technology learning in the workplace informs CTPD design and vice versa, emphasises the interaction and relationship between applied and basic research. This approach stresses the significant role of theory building with regard to how teacher educators learn in the workplace, and the role of this theory construction in informing CTPD design practices (McKenney & Reeves, 2012).

3.7.1 Characterising design research

Educational design research employs a *process-oriented scenario*, wherein the researcher tries to analyse, understand, refine and improve the interventions, and the research is: 1) *interventionist*, aiming at developing and designing intervention strategies situated in the real world rather than in the laboratory; 2) *iterative*, based on a cyclic process of designing and producing new learning theories and practices; 3) *utility oriented*, focussed on the practicality of the prototype for users in the real world; 4) *theory oriented*, in "that the research design is at least partly based upon a conceptual framework and theoretical propositions" (Van den Akker et al, 2006: 4). These design-based research characteristics Reeves et al., 2005; Van den Akker et al., 2006; Van Aken & Andriessen, 2011). are described in more detail below.

Interventionist. In tandem with the construction of new theory and understanding that can serve the design and development of educational interventions, design research attempts to improve educational practice by "bringing about transformation through the design and use of solutions to real problems" (McKenney & Reeves, 2012: 14). In this research, a design-based approach is appropriate because of the pragmatic desire to improve teacher educators' technology learning informed by a theoretical perspective (Newman, 1990). The design-based research approach starts with the identification of teacher educators' "significant problems in need of innovative solutions appropriate for scientific inquiry" (McKenney & Reeves, 2012: 14). While conducting the research, the researcher engages in a process of designing and developing solutions informed by data; for example, from interviews, academic literature, and questionnaires, which means that the research is highly interventionist (Van den Akker, 1999; de Wolf, 2002; Van den Akker et al., 2006; Plomp & Nieveen, 2010; McKenney & Reeves, 2012).

The research is *utility oriented* because it strives to design solutions with regard to teacher educators' technology professionalisation in real work and learning activities which have a positive effect on their practice. The premise is that a systematic integration of research and design in an iterative process is significant in development and testing to bring the interventions closer to the desired design outcomes and research outputs (Van den Akker et al., 2006; Plomp & Nieveen, 2010; Schildwacht, 2012).

Iterative. The insights into teacher educators' technology learning evolve over time through several cycles of investigation, design, development, testing, and refinement of the different prototypes of the TLP-instrument. The development of the prototypes are tested and refined based on formative evaluations. During this process, interaction with teacher educators is needed to clarify possible problems and potential solutions (Plomp & Nieveen, 2010). In contrast to other research traditions, in which data is first collected and then analysed, the iterations of this investigation match with the grounded theory approach in which data collection and analysis work in tandem.

Theory oriented. Design-based research contributes to or expands on existing theory: "A defining difference of most disciplined research is that it uses existing theories or models to frame inquiry" (McKenney & Reeves, 2012: 13). This is in line with Dunne (2011) and Thornberg's (2012) view about the use of a grounded theory approach in research, which claims that the researcher "should seek advantage of the pre-existing body of related literature to see further" (Thornberg, 2012: 91). The theoretical aspects in design-based research are different in that the theory is used to design the research, and the theory has the added dimension of shaping the design of prototypes or outcomes to address an educational problem or issue. This means that design-based research may draw upon and contribute to understanding teacher educators' technology learning in the workplace.

3.7.2 Design-based research phases

As Plomp and Nieveen (2010: 12-13) point out, "design-based research is relevant for educational practice as it aims to develop research-based solutions for complex problems in educational practice". Given the context of teacher educators' technology professionalisation in the workplace as the focus of this research, design-based research enables the researcher to

design and develop effective “interventions in their target contexts” (Plomp & Nieveen, 2010: 13).

The research process in design-based research is based on educational design processes, and as a result, the process is like other “systematic educational and instructional design processes, cyclical in character” (Plomp & Nieveen, 2010: 13). The added value is to be found in the fact that design-based research through research-based interventions provides a systematic approach for designing, developing and evaluating teacher educators’ technology learning interventions. The research also aims to develop knowledge about teacher educators’ technology professionalisation in a broader context, which aligns with grounded theory (see Section 3.5) as a suitable methodology in developing theory about teacher educators’ technology learning.

Although researchers vary in the details of how they picture design research (McKenney, 2001; Reeves, 2000, 2006; Wademan, 2005, Van Aken & Andriessen, 2011), they all agree that a design-based approach “comprises a number of stages or phases” (Plomp & Nieveen, 2010: 13). Building on existing models for design-based research in educational contexts (McKenney, 2001; Reeves, 2001, 2006; Wademan, 2005), the model in Figure 3.2 portrays the overall research process with its three core phases or stages in a flexible and iterative structure: the preliminary phase, the design and prototyping phase, and the assessment or retrospective phase.

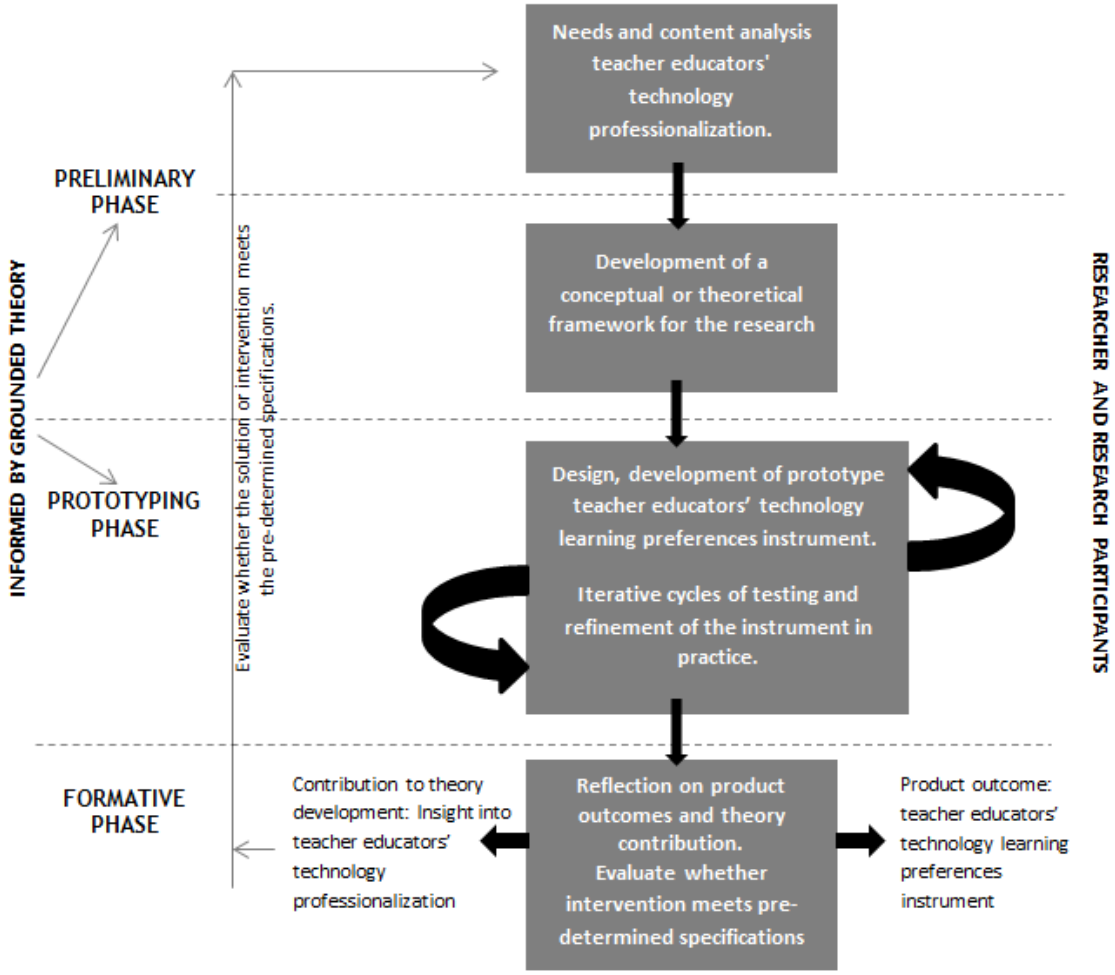


Figure 3.2 *A design-based research model for conducting research about teacher educators' technology professionalisation*[2]

The design-based research model shows that the investigation of teacher educators' technology learning in the workplace progresses through three main phases. Because each phase involves an interaction between the researcher, research participants and practice, the process contributes to theory building and practical results. The research model shown in Figure 3.2 depicts four squares, of which the first two squares represent the preliminary core phase based on Wademan's (2005) model. In this phase, a clear distinction is made between the process of defining teacher educators' technology professionalisation in context, and the follow-up process

[2]Adapted and devised from Reeves, T. (2006) Design research from a technology perspective. In J. van den Akker, K. Gravemeijer, S. McKenney & N. Nieveen (eds), *Educational design research* (pp. 52-66). London: Routledge, and Wademan, M. (2005) *Utilizing Development Research to Guide People Capability Maturity Model Adoption Considerations.* Unpublished doctoral dissertation. New York: Syracuse University.

that focusses on “the development of a conceptual or theoretical framework” based on a literature review (Plomp & Nieveen, 2010: 25).

3.8 Reasons for and advantages of using mixed methods

According to several researchers working in the field of mixed methods, the fundamental principle of using a mixed-methods research approach is that multiple methods have complementary strengths and non-overlapping weaknesses (Tashakkori & Teddlie, 1998; Greene, 2007; Creswell & Plano Clark, 2011). This complementarity makes a mixed-methods research approach “necessary to uncover maximum information and perspective, increase corroboration of the data, and render less biased and more accurate conclusions” (Reams & Twale, 2008: 133).

Using a mixed-methods approach in this research makes it possible to construct meaning which is not only based on a singular version of the truth and reality, but on multiple versions such that knowledge or meaning can be seen as sometimes subjective and sometimes objective. In this research, the approach is oriented toward solving practical problems in the real world of teacher educators’ technology learning. Focusing on utility and practical outcomes means that the research should be judged according to whether it has enabled the researcher to answer the research questions, regardless of whether the process of collecting data is based on a quantitative or qualitative approach (Feilzer, 2010).

3.9 Methods

This section discusses the methods that were used to gather the data necessary to examine the research questions. The first part will provide a critical discussion about participant sampling procedures. The second part will critically discuss the use of a web-based questionnaire as well as the data collection and analysis procedures. The third part will focus on the collection of data from semi-structured interviews, including group interviews, and the analysis process. Next, attention will be paid to the collection and analysis of data from the reflective reports.

3.9.1 Participant sampling procedures

The method used to select participants for this study is based on a mixed methods sampling strategy (Kemper, Stringfield, & Teddlie, 2003). The aim of the preliminary research phase is to explore teacher educators' technology learning style preferences, as a more comprehensive understanding is needed for design and optimisation of the prototype instruments. In this initial phase, all teacher educators (N=179) within the researcher's teacher-education institution will be invited to participate in an online web-based survey. To more closely examine their technology-based learning preferences in the workplace and gain greater insight into the different technology learning style preferences, survey participants who complete the web-based questionnaire will be asked whether they are willing to participate in a follow-up semi-structured interview. To adequately represent the target group of teacher educators, 11 of those who indicate willingness to participate in the follow–up interview will be selected from all six teams as discussed in Chapter 1.

The primary purpose of the TLP instrument is to enable teacher educators to provide information about their preferred way of learning about technology. The information gleaned from the first draft of the TLP questionnaire will be used to inform discussions in semi-structured group interviews during the second phase of instrument development. Insights from the first-draft questionnaire and subsequent interviews will be used to refine the TLP instrument. Both for practical considerations and for reasons of sample saturation, an additional six teacher educators who consented to participate will be purposefully selected to complete the second draft of the TLP questionnaire and participate in a second semi-structured group interview in order to extend insight into how effectively the TLP instrument assesses teacher educators' preferred technology learning style.

To continue the refinement process and further determine the extent to which the TLP instrument effectively assesses technology learning preferences within the researcher's teacher education institution, a purpose sampling approach (Patton, 2002; Schwandt, 2005) will be used during the third phase of prototype creation. In this final stage of the instrument design process, a small number of research participants will be chosen from among the three main interdisciplinary teams, Alpha, Beta and Gamma. All research participants who consented during completion of the initial web-based questionnaire to volunteer further in the investigation

will be considered candidates for this last phase. The selection of research participants within each team will be made using a semi-random method in which a list with participants will be created and ordered according to their number of years of service. From this list, 12 participants will be chosen at random from each of the following groups: 0-5 years of service, 6-10 years of service, 11-20 years of service and 21 plus years of service. Participants will be asked to write in a reflective way the answers to the questions which are part of the interview guide from the semi-structured group interviews. In this way, teacher educators will have a chance to write down their personal views, experiences or ideas with regard to technology learning without being directly influenced by the other group members.

3.9.2 Web-based questionnaires

Web-based questionnaires offer an effective method to collect quantitative data from a large group of participants (Archer, 2003; O'Neill, 2004; West, 2007; Dörnyei & Taguchi, 2010), and they are generally straightforward to analyse. Their effectiveness stems from researchers' ability to create and publish their own questions for distribution flexibly and inexpensively via email, websites or virtual learning environments. Confidentiality and anonymity are also enhanced, which might increase the response rate. In this research, a structured, closed-ended, web-based questionnaire based on the conceptual framework will be used to determine teacher educators' technology learning preferences for informal and formal as well as individual and collective learning in the workplace. This is in line with Teddlie and Tashakkori's (2003: 305) view, who state that questionnaires are "good for analysing attitudes and eliciting other content from research participants". As a research technique, e-questionnaires completed by participants require minimal participation by the researcher, and thus decreases researchers' bias while collecting and analysing data.

Because a web-based survey is a quantitative research instrument, the questionnaire cannot thoroughly examine the details of teacher educators' technology learning or offer exploratory possibilities, as indicated by Bryman (2012). Questionnaires are standardised, so it is not possible to explain any points in the questions that participants might misinterpret. This drawback, however, will be partially solved by piloting the questions in a small group of teacher

educators. Additionally, a web-based questionnaire could encourage respondents to answer superficially, especially if it takes a long time to complete (Kirakowski, 1997; Bryman, 2012).

3.9.3 Data collection: web-based questionnaire

The first research question asks what kinds of formal and informal technology learning activities and contexts teacher educators prefer to use as part of their technology professionalisation. The second research question explores why teacher educators have preferences for particular individual and collective learning activities and contexts. To address both research questions in an explorative way, the preliminary research phase includes a web-based questionnaire consisting of 34 questions. The web-based questionnaire is to be found in Appendix 1. The questions were derived from the literature discussed in Chapter 2. The questionnaire consists of 5 sections: Section 1 collects demographic information about the participants' gender, their age, the subjects they teach, and the number of years they have taught. Sections 2–4 consist of 25 questions to collect explorative data about technology learning preferences. Section 5 includes contact information concerning follow-up research. Closed- and open-ended questions will be included because open-ended questions offer the participants an opportunity to express their opinions in a free-flowing manner. These questions do not have a predetermined set of responses, and the respondent is free to answer whatever he or she believes is right. By including open format questions in the questionnaire, true, insightful and unexpected suggestions can be collected. One of the main advantages of including closed questions in the questionnaire is the ease of performing explorative analysis since this is the aim of the preliminary research phase. Closed questions are suitable for calculating descriptive statistical data and percentages because the answer set is known.

The design and development of the web-based questionnaire will be piloted online using the specialised commercial service FreeOnlineSurveys (www.freeonlinesurveys.com) with a small sample (N = 6) of teacher educators from a different Dutch teacher education institution. The feedback from the respondents will be used to refine and modify the questions before the survey will be made available to the larger group of participants in the research. The link to the web-based questionnaire will be unique and connected to the email address of the recipient. All 179 teacher educators of the teacher education institution will be kindly requested to give their

time to complete the survey voluntarily. The survey is to be found in Appendix 1. Additionally, research participants will be provided with a consent form outlining the purpose of the study and the steps taken to protect privacy and confidentiality. An example of the consent form is to be found in Appendix 8.

3.9.4 Data analysis: web-based questionnaire

Because the aim of the web-based questionnaire is to explore teacher educators' technology learning preferences and activities, descriptive statistics will be used to report the findings on technology learning. The dataset from the web-based questionnaire will be analysed in the statistical software package SPSS Statistics 21. The use of descriptive statistics during the preliminary research phase has the following advantages: (1) it collects and summarises data and information in a manageable and organized manner; (2) it is a fairly straightforward process that can easily translate results into a distribution of frequency, percentages and overall averages; (3) it establishes standard deviations which measure the dispersal or range of scores; (4) it deals with immediate data and single variables rather than trying to establish conclusions; and (5) it may identify ideas that are significant for further qualitative research.

3.9.5 Semi-structured interviews

Using interviews in educational research marks a move away from seeing the responses of research participants as merely numerical data and enables the researcher to explore subjective issues and complex problems which cannot be accessed through questionnaires (Richards, 2003; Hesse-Biber & Leavy, 2006; Kvale & Brinkmann, 2009). As Kvale (1996) and Kvale and Brinkmann (2009) point out, an interview is an "interchange" of views between different people such as the researcher and the research participant. Human interaction (Kvale & Brinkmann, 2009) is a means for knowledge production and emphasises "the social situatedness of research data" (Cohen et al, 2011: 409), giving the research participant a voice. However, interviews in research are not exclusively subjective or objective Kvale, 1996; Kvale & Brinkmann, 2009). Walford (2009: 90) supports this view by stating that "interviewers and interviewees co-construct the interview". This means that the research participant and researcher will define their own realities, and therefore the interview will inevitably have bias.

This view is supported by Barker and Johnson (1998) who argue that the interview is far from neutral. In this research, the interview as a research method enables the researcher to investigate the way in which teacher educators construct their social world, their reality, and as a result do justice to their own situated learning.

The interview can be regarded as a flexible research instrument for collecting data, since the researcher can decide the order and wording of the questions. Whereas the questionnaire is very static, the interview offers more space for spontaneous responses that can raise new issues or questions about teacher educators' technology learning, which can be used in follow-up interviews during the design-based research phases (Gummesson, 1999; Patton, 2002; Payne & Grew, 2005). The use of semi-structured interviews allows the researcher to formulate relevant questions to discover what teacher educators are truly concerned with in regard to their technology professionalisation. The interviews are structured to allow for comparisons between the interviews, while allowing the conversation process to flow naturally. In this way, the semi-structured interviews support the collection of in-depth data from a smaller sample of research participants.

3.9.6 Data collection: semi-structured interviews

The semi-structured interviews and interview processes will be piloted at another Dutch teacher education institution to perform an initial evaluation of the interview process. This will provide an opportunity to test the validity of the questions and themes and to test practical issues such as the interview length (Burgess et al., 2006). All semi-structured interviews will be recorded using a voice recording app on a smartphone and then transcribed.

The first round of interviews will be conducted during the preliminary research phase. To address the research questions and gain greater insight into the different technology learning preferences, the results and insights from the web-based questionnaire and the literature review discussed in Chapter 2 will inform the development of the semi-structured interviews during the preliminary research phase. These interviews will consist of general questions about technology professionalisation and questions about teacher educators' preferred technology learning in the workplace. The interview guide is to be found in Appendix

2. The results and insights from the semi-structured interviews will be used to inform the design and development of the questions during the prototype phases of the TLP-instrument.

To answer Research Question 4, data about the use of the TLP-instrument will be gathered during the second phase of prototyping and evaluation. During Prototype Phase II, five individual semi-structured interviews will be conducted. The teacher educators who are selected to participate in the interviews work in the department for foreign languages which is one of the departments within the teacher education institution in which the research will be conducted (see Chapter 1 for an overview of the teams). By selecting participants from different teams minimises the likelihood of the teachers to discuss the questions outside of the interview process. These teacher educators will have been asked to indicate on the web-based questionnaire that they are willing to participate in the interview process. The selection will be refined by using a semi-random method in which a list of teacher educators will be created and ordered according to their number of years of service. A teacher educator will be chosen at random from each of the following groups: 0-5 years, 6-10 years, 11-20 years and 21 years plus. The interviews will be recorded using a voice recording app on a smartphone and then transcribed.

During Prototype Phase III, teacher educators from the three main interdisciplinary teams will be selected to participate in three semi-structured interviews (see Chapter 1 for an overview of the teams). The teacher educators that will be selected to participate in the three group interviews all work in one of the six departments within the teacher education institution. The selection of participants will be based on the same selection method as discussed earlier.

3.9.7 Reflective reports

Research methods that involve participants writing down their experiences, views and feelings are known as reflective report methods. The great advantage of reflective reports is that they provide the researcher with information about the participants' views and ideas directly. The reports offer access to phenomenological data such as the respondents' perceptions of themselves and their world. A disadvantage of reflective reports is that there are several validity problems associated with them. Research participants may not always be trustworthy and may deceive themselves or the researcher, and information that the participant provides is not

always the actual truth. Research participants may not provide the level of detail or use the concepts or ideas that directly relate to the issues under investigation.

These limitations of the reflective report as a qualitative data collection method are important to consider while conducting research, but this does not mean that the use of reflective reports to collect data in educational contexts is invalid (Ericsson & Simon, 1993; Fisher & Katz, 2008). All measurement methods have their limits, and the potential limitations should be considered during the data analysis and interpretation phases. Using different data collection and analysis methods also contributes to triangulation: Seeking "convergence and corroboration of results from different methods" and designs researching "the same phenomenon" is indeed one of the five major purposes or rationales "for mixed methods" (Biesta, 2012: 147).

3.9.8 Data collection: reflective reports

The collection of data from the reflective reports will take place simultaneously with the semi-structured group interviews during the third phase of prototyping and evaluation. Research participants will be provided with the same interview guide as the one used during the three semi-structured group interviews. There is an important difference in that the teacher educators will be asked to answer each question individually before the question will be discussed during the group interview. Sufficient time will be given for participants to reflect on the questions and to write down personal views, ideas or experiences concerning CTPD. Providing the questions before they are discussed in the group is intended to minimise the influence of other participants' views, ideas and experiences. Additionally, the questions may help give a voice to the individual participant during the data collection and analysis process. An overview of the reflective reports and TLP-instrument is to be found in Appendix 6 and 7.

3.9.9 Data analysis of qualitative research methods

Coding will be used to capture the content of the interview data and reflective reports, to learn how teacher educators make sense of their technology professionalisation experiences and how they act on them. Coding the data is the first step in the analysis process, as it helps to move away from more particular statements to more abstract interpretations or concepts of the

data (Charmaz, 2006). The analysis of coding will be performed with a computer-assisted qualitative data analysis software (CAQDAS) package called ATLAS.ti 7.0.

Informed by a grounded theory approach and existing literature, several coding techniques will be used to examine the research participants' accounts. Open coding, which is also known as line-by-line coding, will be used to identify initial phenomena with regard to technology learning. Conceptual labels will be attached to almost every line in the semi-structured interview transcript and the reflective reports to capture what the participants will have said in the interviews or will have written in their reflective reports. The codes will be assigned to the research participants' statements to develop concepts and begin the analysis.

The next coding phase, which is known as focussed coding (Charmaz, 2006; Thornberg, 2012), is more abstract than the open coding process. Focussed coding will be applied to specific lines or parts in the interview transcripts and texts from the reflective reports, centred on the most telling codes that represent the research participants' voice. In this way, the focussed codes help to verify initial codes when they are applied and tested on transcripts that will be collected later in the research process.

The third phase in the analysis process is based on theoretical coding (Charmaz, 2006; Holton, 2007; Thornberg, 2012). The categories and codes generated from the data will be investigated for possible relationships. For this process of coding, theoretical codes will be used that were found in pre-existing theories discussed in Chapter 2. This process may give a broader perspective or new perspectives on technology learning and addresses the research questions in more depth.

3.10 Writing memos

During the collection of data and the coding and analysing of the qualitative data, the researcher will write down ideas and thoughts in memos. The use of memos is helpful to make field notes on teacher educators' experiences, concerns and issues about their technology professionalisation and questions that demand answers later in the research. The memos help with the investigation of codes and categories during the data gathering and analysing. Memos help to gain distance from the data and codes as they consist of ideas written down during the

research process. ATLAS.ti 7.0 makes it possible to store and order memos that may be of use while analysing data.

3.11 Ethical issues

There are ethical considerations in the way the data will be conducted, stored, analysed and presented. In conducting the interviews ethically it is necessary to ensure that the research participants are treated with respect, that views and opinions are handled sensitively and that the participation is voluntary and not coerced in any way. Whilst it is impossible to eliminate all risk as the data collection processes will take place in the 'real' world, the ethical responsibility is to consider risk and make the research participants aware of that risk. The following ethical issues are considered in conducting the research using Punch's (2000) ethical consideration as a starting point:

Informed consent

All interviewees will be sent a transcript of their interviews. This is to ensure that the participants are satisfied that the transcripts reflect an accurate record of the interviews and it will also give the teacher educators an opportunity to make changes if they feel the transcript does not reflect their actual feelings, or ideas with regard to the issues discussed in the interviews.

Privacy

Teachers educators have the option to withdraw entirely from the research if they wish to. In this research, as in others, the location of the interviews is carefully chosen. It is essential to have a safe research space in which the research participant can speak privately in order that the conversation will not be heard by others and that there will be no interruptions.

Confidentiality and anonymity

As CTPD within the teacher education institution is a personal issue, concerns of privacy and confidentiality such as dissatisfaction about learning opportunities or funds relating to CTPD programmes can arise. All interviews will be transcribed and the research participants will be anonymised to protect their privacy. Data including paper documentation and all digitalized

versions of the data will be securely stored in a locked filing cabinet in the researchers' work office. All digital data that will be stored on the laptop and in the cloud will be password protected and will be discarded after 5 years (Sieber & Tollich, 2012).

3.12 Summary

This chapter made the case for using a design-based research approach informed by grounded theory within the interpretive tradition to examine how a technology learning preferences instrument should be designed to support teacher educators' technology learning in the workplace. The approach employed will be constructionism. Since social constructionism focusses on knowledge construction dependent on the interaction between humans and the world, the choice of grounded theory as a research methodology clearly matches the epistemological stance discussed in Section 3.4. Constructing new knowledge occurs through the examination and interpretation of data in the context of the research questions, and therefore the knowledge claims are limited to the localised boundaries of the research. Situating the investigation in an interpretive tradition means that claims can be specific to the particular context rather than generalised, and any new knowledge that is created is validated by the context and the processes that have occurred. The discussion included a consideration of the ethical implications of performing the research and limitations in using subjective research methods and qualitative data. The next chapter presents and critically evaluates the process of analysis.

Chapter 4:

Critical reflection on the data collection and analysis

4.1 Introduction

Chapter 3 presented a critical discussion of the research approach and the methods in relation to the four research questions. This chapter discusses the data collection and analysis procedures and critically reflects upon the processes. The data analysis was primarily an inductive process, which began during the data collection process and continued through the analysis of raw data from the methods used in the preliminary research phase. As the research took an interpretivist stance, multiple readings and interpretations were involved (Thomas, 2003).

The critical discussion in this chapter consists of three parts: 1) a critical reflection on the use of the research methodology and the research methods, 2) a critical analysis of the coding process and 3) a critical reflection on the data collection and data analysis processes.

4.2 Brief overview of the field research

The research was undertaken with the dual goals of gaining a better understanding of teacher educators' CTPD in the workplace and the development of a TLP-instrument that supports the research participants' technology professionalisation. The research is informed by existing research but started with only a partial theory about technology learning and proceeded with a goal of elaborating on existing theory.

As discussed in Chapter 2, the research on CTPD with regard to teacher educators' technology learning preferences is scarce, and to fill in the gap in the literature, a diversity of research methods was used to address the four research questions discussed in Chapter 1. Using a design-based research approach, data were collected in an iterative way using a web-based questionnaire that explored teacher educators' preferred ways of acquiring technology knowledge and skills. The insights from the web-based questionnaire informed the design of semi-structured interviews with 11 teacher educators. The semi-structured interviews were used to gain a more profound understanding of educators' preferred ways of technology learning.

Table 4.1 presents an overview of the field research in order to address the four research questions. The results from the web-based questionnaire and the 11 semi-structured interviews

Table 4.1 *Data collection and analysis processes*

Time line	Data collection	Data analysis	Analysis method	Design-phase	
October 2011	*Web-based questionnaire* N=103	Descriptive statistics	SPSS Statistics 21	Preliminary research phase	Memo writing
March–April 2012	*Semi-structured interviews* N=11 Teacher educators from all teams	Open coding	Coding with ATLAS.ti 7.0		
March–April 2014	*Expert reviews TLP-questionnaire* N=5	Text analysis	Word processor	Prototype and evaluation phase I	Memo writing
January and March 2015	*Semi-structured interviews* N=5 Teacher educators foreign languages	Focused coding	Coding with ATLAS.ti 7.0	Prototype and evaluation phase II	Memo writing
April–May 2015	*Three semi-structured group interviews* N=12 Teacher educators	Theoretical coding	Coding with ATLAS.ti 7.0	Prototype and evaluation phase III	Memo writing
April–May 2015	*Reflective reports* N=12	Focused and theoretical coding	Word processor and Coding with ATLAS.ti 7.0		

were used to develop a concept model. This concept model postulates the existence of two primary learning dimensions based on the theory discussed in Chapter 2 and the four combined learning modes that emerged during the analysis of the data during the preliminary research phase.

Based on the literature review and the results of the preliminary research phase, 48

questions were formulated during prototype and evaluation phase I which were part of the TLP-instrument. Five experts provided review evaluations, and their recommendations were used for subsequent modification of the TLP-questionnaire during phases I and II. To address research question 4, prototype phase II involved the refinement of the TLP-questionnaire and further development of the TLP-instrument. To collect data about the use of the TLP-instrument, five semi-structured interviews were conducted with teacher educators of foreign languages. The data from the semi-structured interviews were examined and yielded more in-depth information with regard to the four research questions. Additionally, small modifications and refinements were conducted concerning the design of the following prototype. During prototype and evaluation phase III, three semi-structured group interviews and reflective reports were used to collect data with the aim to generate understanding that might be transferable to other CTPD settings.

4.3 Critical reflection on the use of grounded theory

For this research, a grounded theory methodology was used. Although grounded theory scholars have different opinions about the most suitable time to review the literature, this research has followed the advice of Charmaz (2006) and (Thornberg, 2012) in conducting an initial review of the literature before the first data collection in the form of a web-based questionnaire. The reason for an early review of the literature was to examine whether any similar research had been conducted in the area of investigation. The insights from the literature were used to design and develop the basic themes in the questionnaire.

An initial analysis of the web-based questionnaire during the preliminary research phase revealed that it was not sufficient to base the research on existing theory but that an inductive approach through the use of a grounded theory methodology would support a more in-depth investigation on teacher educators' technology learning in the workplace through the participants' eyes. The decision to use a grounded theory methodology turned out to be very useful.

Grounded theory involves the practice of collecting and analysing data at its very heart and for this reason the methodology turned out to be useful for investigating the four research questions through memo writing and creating diagrams and Network Views in Atlas.ti. 7.0. In

this research, memos were elaborations of the researcher with regard to the codes that had been generated. Most memos consisted of only a few sentences or statements which were mostly based on several hunches, ideas, views or observations. However, throughout the iterative research process, these memos were frequently revisited and elaborated, and they were merged with others to develop meaning. Diagrams and Network Views helped to 'play' with the concepts which assisted in sorting codes, investigating comparisons, identifying categories and, most importantly, understanding the connections between the concepts related to the four research questions.

During the research process, it was found that the reflexivity inherent in the theoretical sampling and memo-writing process was foundational to producing a piece of work that was both rigorous and transparent. The reflexive process allowed for developing an 'analytic story' that was a meaningful and legitimate interpretation of the area of investigation.

4.4 Critical reflection on design-based research

Design-based research provided a productive perspective in this investigation for developing a TLP-instrument that supports teacher educators in their technology professionalisation trajectories. The iterative process of investigation made it possible to identify inconsistencies in the design process of the TLP-instrument prototypes and allowed for decisions about choosing additional data collection methods to explore more in depth the research issues as defined in the research questions.

Another argument why design-based research proved to be effective was that this research involved teacher educators representing a wide range of expertise in different fields of teaching. The voice of these teacher educators through the collection and analysis of the data in different research phases not only contributed to the design and development of the TLP-instrument but also to a more profound understanding of technology learning in the workplace. In addition, the participants were treated as co-participants in the design and even at particular moments in the analysis of the data.

As Barab and Squire (2004: 4) argued in their research, one challenging aspect of design-based research is to "characterize the complexity, fragility, messiness, and eventual solidity of the design and doing so in a way that will be valuable to others". This implies that

design-based research requires more than simply understanding what happens in one situation but also requires the researcher to make the findings derived from a local context relevant to other contexts. As design-based research strives to contribute to theory that transcends the particulars of the local research context, generating theory which has more distant relevance turned out to be a most difficult task in this research. However, despite the fact that it was critical and challenging to make arguments based on the findings in this research about technology learning that has both local relevance as well as distant relevance, the use of design-based research informed by grounded theory which employs mixed methods turned out to be useful.

4.5 Multiple roles during the data collection process

Researchers who are involved in design, implementation and evaluation processes may find themselves in different 'membership roles' (Adler & Adler, 1987) which can be of conflicting natures. Whether the researcher is a member of the group of participants being studied and sharing characteristics or equal roles and experiences, or being the outsider and not sharing the same commonality, including the researcher's role is an essential aspect of the investigation. The issue of the researcher as an outsider has been widely explored and discussed by several scholars in the field of education (Rose, 1985; Adler & Adler, 1987; Schwartzmann, 1993; Kanuha, 2000; Serrant-Green, 2002; Asselin, 2003; Angrosino, 2005; Brannick & Coghlan, 2007; Drake, 2010).

The multiple roles of the researcher can be considered to be either a productive or counter-productive force and can contribute to balanced solutions with regard to the research problem. On one hand, participation might help the researcher to gain a more profound understanding of the phenomena under study. On the other hand, being involved as a teacher educator and researcher in the design, development and evaluation processes may increase the chances of an evaluator effect. According to Kanuha (2000), *insider research* refers to when the researcher conducts research with research participants in a group of which the researcher himself or herself is also a member and for that reason shares similar aspects such as identity, expertise and an experiential base (Asselin, 2003). *Outsider research* refers to the researcher

who conducts research with participants in a group of which the researcher himself is not a member and does not share the same status.

In this research, the researcher worked in close cooperation with teacher educators of a Dutch teacher education institution and combined his role as a researcher and co-designer with the role of a teacher educator. The benefit of being a member of the group under study was acceptance, since the researcher's membership did not automatically provide a certain level of openness and trust in the group of teacher educators. This was a challenge with those educators who were not direct colleagues of the researcher. Gaining confidence took not only time, but it was difficult to find a brief window of opportunity to convince several participants that the research was worthwhile. However, being clear about the aims and procedures of this research and the fact that the researcher himself was a teacher educator made it possible to collect data in an informal way. This would likely not have been the case if the researcher had been an outsider. This was explicitly stated shortly after an interview with one of the teacher educators:

> "It is great that you are investigating possibilities to improve our technology professionalisation. You know how it works here … in fact, it doesn't. You know that the usual innovation days are not designed according to our needs and wishes. They are … in most cases the workshops that we can choose from are not interesting and do not suit its purpose. I would be very interested how we can change this for the better … so, if this interview helps … you and me to see what works … that would be great." (Teacher educator AM-Prelim)

Another teacher educator stated:

> "I am glad to see that someone who knows what it means to be a teacher educator and is listening to what we need in order to become more ICT savvy teachers." (Teacher educator KC-Prelim)

The insider's role helped to understand teacher educators' beliefs and ideas concerning their technology learning preferences based on their needs and wishes. The inside perspective was enhanced through conducting the semi-structured interviews and proved to be beneficial not only during the preliminary research phase but to the overall study outcomes as well.

- Being a member of the group made it possible to design a prototype appropriate for the learning context of the teacher educator.
- Being a member of the group helped to obtain collaboration during the data collection processes, which contributed to a more profound analysis of the data concerning teacher educators' technology learning preferences.
- Being a member of the group created a feeling of 'us versus them' (those managers and administrators who do not understand). In fact it gave participants a feeling of having a representative who was standing up for their ideas and beliefs.

However, during the course of critically reflecting on the process of data collection, methodological concerns were raised related to the notion that as the researcher conducted the investigation himself, the potential for evaluation effect could increase (Patton, 2001). During the semi-structured interviews, participants might have responded in a certain way due to the fact that the researcher himself was a member of the teaching staff. In other words, socially desirable responses could increase when teacher educators were aware that the researcher would also be the designer of the instrument during the prototype research phase. This phenomenon is commonly known as the *Hawthorne effect* (Landsberger, 1958; Advin, 1984; Levitt & List, 2011), meaning that the researcher's insider participation in this research could influence teacher educators' ideas, views and behaviour. Moreover, the researcher himself may be less receptive to specific clues, details and criticism. This is in line with Putnam and Borko (2000: 13), who state that

> "Rather than pretending to be objective observers, we must be careful to consider our role in influencing and shaping the phenomena we study. This issue is obvious when individuals take on multiple roles of researchers, teachers, teachers of teachers."

To address this entanglement in the research process, the researcher shared his feelings and views with other colleagues outside the teacher education institution and with other doctoral students. This helped him to develop some distance and objectivity about the collected data.

Through this, the researcher became aware of the notion of 'they' (the research participants) versus 'me' (the researcher). The discussions with others and the possibility to exchange views and ideas enabled the researcher to understand and deal with personal thoughts and inner constructs, which enabled him to draw a line between his own technology learning experiences and the research participants' experiences. Additionally, to minimise bias during the data collection and analysis process, several research methods were used, as discussed in Chapter 3.

4.6 Use of software for data management and analysis

For this study, mainly the qualitative analysis software ATLAS.ti 7.0 was used to support the analysis process and to help manage the interview data. In this way it was easier to resort the material and redefine the codes which increased the speed of tasks. A CAQDAS package facilitated following potentially promising analytic routes but also enabled these routes to be discontinued with ease. The dynamic possibilities of ATLAS.ti 7.0 assisted in the reflection on the data and the connections between the data.

4.6.1 Enhancing the analysis process with ATLAS.ti 7.0

In this research, ATLAS.ti 7.0 served as a user-friendly CAQDAS package that allowed the researcher to make use of primary data sources such as text and audio files which could then be analysed in a systematic way. As the coding process was a developmental process according to the iterative investigation, the process of exploring ATLAS.ti. 7.0 ended up being a developmental process as well.

As discussed earlier in Chapter 3, the qualitative data in this research is made up of words, which aim to describe issues concerning teacher educators' technology learning. The type of data is made up of semi-structured (group) interviews and participants' reflective reports.

Qualitative data analysis is in some ways more subjective, as it depends on analysis by one researcher or a team of researchers. Due to the subjectivity of the analysis, qualitative findings are seen to lack generalisability and are therefore not necessarily directly transferable to situations outside the investigated research context. However, the strength of qualitative data

analysis in this research was that it provided an in-depth and interpreted understanding of the research participants' professional learning in the workplace.

The use of ATLAS.ti 7.0 enhanced the analysis process of raw data and contributed to rigour in this research. Through ATLAS.ti, it was possible to store, organise and code text documents in a systematic way. The first step in the process of analysing the data started with the transcription of the semi-structured interviews in a word processing application so as to make the audio files text-based and suitable for analysis in ATLAS.ti. The following step involved the process of assigning codes to the raw data with the aim to associate them with multiple different codes. In this way, the information linked to the data analysis was kept together, and this made it easier to search for particular patterns, which in turn advanced the analytical process. Lexical searching in ATLAS.ti made it possible to search for certain word roots associated with particular themes, particular codes or emerging theoretical concepts in the context of technology professionalisation and factors that promote technology learning. As this process yielded new ideas and suggestions to search in a more profound way for new codes or themes, existing themes and codes could be "checked for occurrence of negatives cases—that is, cases that were considered to be inconsistent" (Gibbs, 2012: 256) with the initial assumptions. Reflexivity in this context is an important part of qualitative research (Long & Johnson, 2000). Basically, "actions and decisions" in the analysis process "will inevitably impact upon the meaning and context of the experience under investigation" (Horsburgh, 2003: 308). Mays and Pope (2000: 51) state that "reflexivity means sensitivity to the ways in which the researcher and the research process have shaped the collected data, including the role of prior assumptions and experience, which can influence even the most avowedly inductive inquiries".

ATLAS.ti 7.0 therefore allowed for more quick, thorough and scientific qualitative data analysis which helped to

> "Automate and thus speed up and liven up the coding process; provide a more complex way of looking at the relationships in the data; provide a formal structure for writing and storing memos to develop the analysis and aid more conceptual and theoretical thinking about the data." (Barry, 1998: 1)

Using ATLAS.ti. 7.0 made it easier to manage a fairly large quantity of data (teacher educators' statements) rather than the manual process of organising and analysing data. In particular, ATLAS.ti 7.0 offered various features for searching the coded texts, finding similarities and dissimilarities, and exploring the entire dataset or retrieving specific quotations in order to support theory-building.

As discussed in Chapter 3, the coding process consisted of three phases: open coding or initial coding, focused coding and theoretical coding. The following sections discuss the analysis process of coding and memoing through the use of ATLAS.ti 7.0.

4.7 Coding process

As mentioned above and discussed in Chapter 3, a grounded theory approach to the collection of data was adopted in the research, and the data were subjected to a rigorous coding process with the aim to identify underlying patterns concerning technology learning in the workplace.

Several questions based on Glaser's (1998) and Charmaz's (2006) suggestions about exploring data were used to guide the analysis of the data word by word and line by line: 'What category does the situation, incident or observation indicate?' 'What concerns were raised by the teacher educators?' 'What are the teacher educators' feelings, thoughts, and ideas with regard to technology professionalisation?' These questions were considered a means to explore and identify in a critical and analytical way what was happening in the data. The open coding of the data started with reading through the interview transcripts, which was then followed by creating codes and categories grounded in the data.

4.7.1 Open coding

The texts from the semi-structured interview transcripts and the reflective reports were initially coded using open coding or initial coding (Glaser, 1998; Charmaz, 2003, 2006). All the transcripts and reflective reports were read, which was then followed by creating codes and categories grounded in the data. The rationale for beginning with this type of free coding was to develop a detailed overview of all the transcripts and to code the text before the prescription of focusing specifically on each of the research issues. As the data collection and analysis took place throughout the research process using a design-based research approach, the

constructed codes were considered provisional and open for modification and refinement based on the iterative approach, as described in Table 4.1.

Using Glaser and Strauss' (1967) comparative method, phenomena or aspects of interest in the qualitative data from the semi-structured interviews and reflective reports were compared in order to find similarities or differences. In this way, codes could be refined or modified into different or new codes. During the final stage of the open coding process, the separate categories were used to identify possible conceptual relationships. Using ATLAS.ti 7.0 made it possible to systematically explore complex phenomena which were implied in the data but were not easily identified. In this way, the first steps were taken to develop the theory.

In order to illustrate the practical process of open coding, examples of the coding sections in transcripts from the semi-structured interviews are presented in Table 4.2.

Table 4.2 *Example of open coding*

Qualitative data from the semi-structured interviews		**Open coding**
Interviewee	Uuuhm … formal learning situations … it was never taken on …	Talking about formal learning
Interviewee	So yes that I consider to be formal, all of us were there, and it was as I said, we never continued with the activity.	Indicating what is formal learning
Interviewee	Well if you think about the outcome, and there was no outcome, … because what is the point of training somebody who you then do not challenge to actually produce a product, and there was no challenge to produce a product.	Expressing feelings, thoughts and experiences
Interviewee	Most of the times they do not answer all the questions you have, or at the end you have more questions and you want to figure out what is good for my classroom situation …	Expressing dissatisfaction
Interviewee	I have a sparring partner … we just take time to discuss things and come up with ideas or improvements through our own way of working.	Talking about exchanging ideas
Interviewee	Well I suppose, being an immigrant, I needed to have, you know, … my colleagues needed to support me with training.	Expressing need for support
Interviewee	I suppose there you can say that the institution did not give me the time nor gave me the stimuli.	Indicating lack of stimuli

4.7.2 Focused coding

Charmaz (2003, 2006) considers the second phase of coding, *focused coding*, as a process which permits the researcher to separate, sort and synthesise data. Using focused codes made it possible to sift through the amounts of data and at the same time enhanced the process of determining the adequacy of the selected codes and contributed to the process of generating theoretical concepts about technology learning.

Focused coding helped to develop the initial codes further. This focused coding phase was more directed and selective than the initial phase of open coding. The focused codes were not meticulously assigned to every single line of interview transcript but made use of some initial concepts to focus on specific issues. These issues were, for example, the respondents' experiences concerning technology learning or what impedes their technology professionalisation. These focused codes particularly guided the development of categories.

The development of categories was facilitated by two intertwined processes: 1) the iterative process of coding, which used different methods to help verify the codes and 2) reflecting on the codes, facilitated by memos, to establish links between codes and tentative categories. In order to give insight into this process, Table 4.3 illustrates the development process of focused codes and shows that the codes during the preliminary data collection and analysis process capture and synthesise the main themes in the teacher educators' interview statements. The separate incidents or teacher educators' statements are compared to other statements in the data to establish possible underlying constructs. Then, emerging theoretical concepts were compared to other incidents as the process of data collection and analysis was ongoing. Holton (2007: 278) emphasises that "the purpose here is theoretical elaboration, saturation, and densification of concepts". A summary of the cluster codes and focused codes is to be found in Appendix 3.

Focused coding constitutes an important link between collecting data and developing theory. Grouping the codes under different headings or themes, together with the writing of memos during the data collection and analysis processes, helped to make sense of the research participants' statements. Particularly relevant codes were explored more in depth—for example, teacher educators' experiences with specific formal learning activities. These could then be interlinked and related to other codes to devise more abstract categories. These

categories were the basis for developing understanding which aimed to explain and predict phenomena based on the data.

Table 4.3 *Example of development of focused codes*

Examples initial coding	→ Clustered code (common theme)	→ Focused code
Expressing dissatisfaction about current training / courses. Talking about feelings, thoughts and experiences concerning training courses. Current training not sufficient. Indicating that content of courses / training does not match with what is needed. Talking about lack of outcome of current training. Indicating that there is not enough time. Talking about the training as not just-in time.	Evidence that current training is not sufficient concerning content and outcome. Inhibitors concerning technology professional development Professionalisation is currently not needs-based	Barriers to and enablers of technology learning
Needed support from colleagues. Mentioning that a personal coach was needed. More concentrated form of guidance.	Evidence that personal support is needed and appreciated while getting training.	Assistance from experts based on learners' needs and wishes
Indicating that the process of exchanging knowledge and skills with other colleagues is useful. Indicating how useful it is to learn from other colleagues while talking with them. Talking about the process of learning. Mentioning preferring to work in groups. Saying that working in small groups is helpful. Talking about collaborating.	Knowledge sharing and exchanging ideas Evidence that working in groups is important while acquiring ICT knowledge and skills.	Preferred collective technology learning

Emerging theoretical concepts

Emerging understanding

4.7.3 Theoretical coding

Following focused coding, theoretical coding was used to identify patterns in the coded text. Theoretical coding identified the developing themes in relation to the patterns which emerged during the focused coding process. The analytical process used in the theoretical coding was based on the use of Network Views in ATLAS.ti 7.0 These Network Views allowed the

researcher to conceptualise the structure by connecting sets of similar elements together in a visual diagram. With the aid of Network Views, relationships between codes, quotations and memos were expressed.

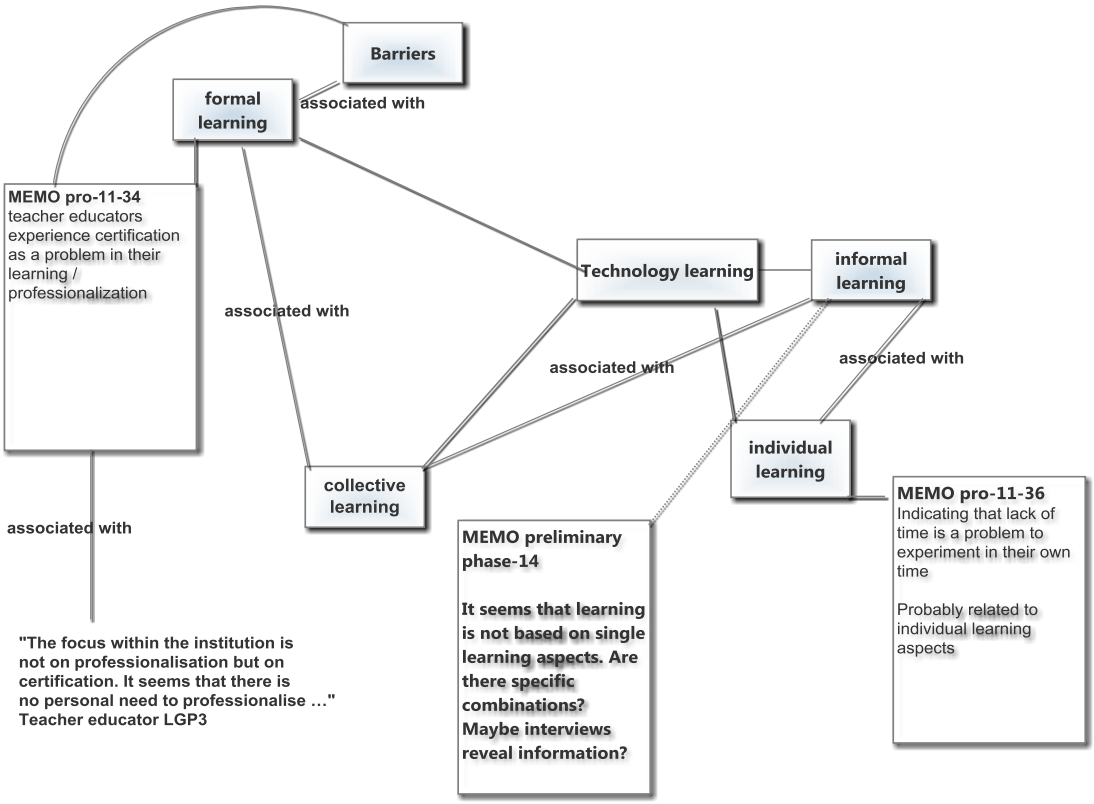


Figure 4.1 *Example of a Network View in Atlas.ti 7.0*

The use of memos allowed insight into the analytical process guided by the grounded theory methodology and reflected the researcher's thoughts and ideas at the time of the data collection and analysis. At the end of the lengthy process of coding, memoing and developing categories, a grounded theory was developed explaining teacher educators' views of technology learning, the barriers that impede the acquisition of ICT knowledge and the skills as well as possible strategies that foster technology learning in the workplace. The following section discusses in a critical way the use of memos during the research process.

4.8 Memo writing

During the data collection and analysis process, the researcher wrote memos as a means to explore possible emergent patterns, which allowed speculation about possible relationships between codes or categories concerning technology professionalisation. This is in line with Lempert (2007: 251), who states that "memo writing is a private conversation between the researcher and his data". As memos 'stand-alone' or may refer to codes, literature or other memos, ATLAS.ti 7.0 made it possible to organise the often messy and incomplete bits and pieces of information in a digitalised way and to create a digital "storehouse of analytical ideas" (Strauss & Corbin, 1998: 220), which served as a fundamental link between data and emergent theory about teacher educators' technology learning.

One of the issues that arose while writing memos was that most of the transcripts did not reveal connections or relationships between codes and other memos upon first glance. This was caused partly by incomplete notes and sentences or incoherent parts which aimed to capture nascent ideas or perceptions. However, as the researcher wrote down anything that seemed to be important, the collection of memos provided a means to reflect on the process of analysing the data and to look for patterns. In this way, thoughts and ideas gradually moved away from the more descriptive accounts to more conceptualised thoughts and ideas.

Most of the early memos began as simple and sometimes awkward statements. However, as the analysis of the data progressed, the memos became more structured and complex. The following memo is an excerpt of portions which illustrate the exploration of the code *Learning preferences*.

Memo Prelim-05

> **Effective technology learning**: Question is what is effective? How effective are the current courses / workshops? Were there any workshops / courses that were useful? How to make them more effective? Current workshops and courses are not teacher-driven. Knowledge is poured into the teacher educators. Not according to their learning needs / wishes. Not needs-based. Facilitation in time is lacking.
>
> Interviewee HR-01: "Well it did not work either, and I think people like me were trying to make an enormous effort. You are going to learn more by

> doing it … but listening to somebody watching him kick all over the place and where was that?". Interviewee GA-01: "Most of these sort of workshops focused on the instrumental skills. Making the transition to the teaching context was something that you had to find out yourself, but this is just what I needed as an inexperienced teacher" (indicating the lack of support / adequate course / workshop).

As the example memo shows, it consists of short sentences and phrases which show that the researcher is still in conversation with the data. Writing memos during the analysis process which included the respondents' voices turned out to be valuable, since it provided "an immediate illustration of the analytical topic" (Lempert, 2007: 256). Moreover, in this way the researcher made a clear link between his own analytical processes of exploring and investigating the data as well as putting the respondents' voices to the forefront.

The following memo illustrates a further development of *Effective technology learning,* which started out as a code and then became more complex and abstract through the reiterative process of analysing and memoing the data in a systematic way. Whereas the previous memo consisted of several questions and incomplete sentences, the second memo began to grow, and analysis started to coalesce.

Memo Prototype II-18

> Current professional development programmes are provided on the basis of just-in-case learning and focus too much on training instrumental skills. Teacher educators experience that learning is disconnected from their educational practice. Technology learning opportunities should focus more on the learners' needs and wishes.

Although the process of writing memos on memos seems endless, investigation by looking for patterns is an important step in bringing order to the data. Refinements were made by cutting and pasting from earlier memos. As a result, the first tentative theoretical insights into teacher educators' technology learning emerged.

4.9 Critical reflection on data collection and analysis: pilot web-based questionnaire

Initial drafts of the web-based questionnaire were piloted with five teacher educators. The five educators were asked by the researcher if they would be willing to participate in the online pilot questionnaire. The pilot questionnaire was administered based on a face-to-face individual meeting. However, due to time constraints, one participant could not participate on the same day and was not willing to participate on another day. To find another volunteer was not easy, and therefore the feedback from the other four participants was considered to be sufficient as no new information was given after the third face-to-face meeting.

All four teacher educators completed the pilot e-questionnaire in the same way that it would be completed with the actual questionnaire. In this way, the researcher could observe the participants and ask questions if applicable. The researcher noted how long the respondents needed to complete the questionnaire and asked about any difficulties the participants encountered while answering the questions or comments they wished to make. These face-to-face meetings for piloting the web-based questionnaire allowed the participants to give verbal feedback, which contributed to the process of modifying and refining the questionnaire.

The four participants were asked questions while completing the web-based questionnaire. Each time they read and answered the questions, they were asked to communicate exactly what came into their minds. The researcher took notes on everything the participants said. Examples include “What do you mean with this question? … oh … yes, I see what you mean” (teacher educator AZ-pilot) or “Is that informal learning?” (teacher educator PJ-pilot). In this way, the critical moments of making a decision in choosing an answer was closely examined. Additionally, notes were taken while observing the participants. Notes were made in those places were respondents hesitated to answer or were they were in doubt. Some of these hesitations were based on questions which were unclear due to sentence construction or jargon.

Based on the notes that were taken during the observations and the critical feedback from the four participants in the pilot, modifications and refinements were made to the actual web-based questionnaire. The actual e-questionnaire was distributed among all teacher educators (N=179) within the teacher education institution using the specialised commercial service FreeOnlineSurveys (www.freeonlinesurveys.com). The link to the web-based

questionnaire was unique and connected to the email address of the recipient. All 179 teacher educators of the teacher education institution were politely requested to give their time to complete the survey voluntarily. The survey is to be found in Appendix 1. Additionally, the participants were provided with a consent form outlining the purpose of the research and the steps taken to protect privacy and confidentiality. An example of the consent form is to be found in Appendix 8.

The results of the survey were automatically gathered in a database and could be downloaded in the form of tabular data which then could be imported into SPSS-21. The advantages of collecting data and analysing data via these electronic surveys included being able to direct respondents to particular sections of the questionnaire depending on the way they answered previous questions. Respondents can be automatically prompted when they provide an invalid response, such as selecting several tick boxes when only one should be marked.

Descriptive statistics and percentages were used to explore the data from the 103 respondents who were willing to complete the web-based questionnaire. The data provided general information about the use of the four single modes of technology learning. The open question (question 30) was analysed using Atlas.ti. 7.0. The qualitative data from this question was used while creating initial codes. The web-based questionnaire turned out to be a useful explorative research method to investigate educators' preferred ways of technology learning. However, to gain greater insight into the different preferences for learning activities, the web-based questionnaire results were limited but could be used to inform the development of the semi-structured interviews.

4.10 Semi-structured interviews preliminary research phase, prototype and evaluation phases II and III

All teacher educators who were selected to participate in the interviews during the preliminary research phase work across all departments of the teacher education institution in the department for foreign languages in different language teams. During the second round of semi-structured interviews, teacher educators were selected from the department of foreign languages. All these teacher educators indicated in the web-based questionnaire that they were willing to participate in further investigations. The selection was refined using a semi-random

method in which a list of teacher educators was created and ordered according to their number of years of service. A teacher educator was chosen at random from each of the following groups: 0–5 years, 6–10 years, 11–20 years and 21 plus years. See Appendix 5 for the interview guide.

The interviews were recorded with a digital voice recorder, and the files were transferred externally for transcription, because as a full-time teacher educator, the researcher did not have time to transcribe the interviews himself, which could have biased the interpretation process. The first task was to organise suitable interview times with each of the participants. The 11 interviews during the preliminary research phase took place between 9 and 26 January, 2012. The five interviews during the prototype and evaluation phase II took place between 9 and 26 January, 2012. The day before each interview, I reminded the participants and confirmed interview times. An interview guide, which can be found in Appendix 2, was based on the results and findings from the web-based interviews during the preliminary research phase. The first round of semi-structured interviews focused on exploring teacher educators' technology learning in the workplace. The interview guide during the prototype and evaluation phase II was based on the results and findings from the previous semi-structured interviews during the preliminary research phase.

The initial interviews during the preliminary research phase centred on Research Questions 1, 2 and 3. Eleven participants from all departments within the teacher education institution talked extensively about their previous technology learning experiences and the ways they preferred to learn knowledge and skills related to emerging technologies with regard to their teaching practice. The interviewing process took place relatively informally, and each audio recorded interview lasted for about 30 to 45 minutes.

The second round of semi-structured interviews was conducted with five teacher educators who all work within the department of foreign languages. The aim was to get a better understanding of the participants' technology learning preferences as well as preferred learning activities. Moreover, the data generated from these interviews give more in depth insights concerning the use of the TLP-instrument as a tool to support teacher educators' technology professionalisation.

However, in any study there are several layers of interpretation with regard to the raw

data. In these research stages, the raw data were the digital recordings of the semi-structured interviews. From an interpretivist perspective, as discussed in Chapter 3, the transcripts are a representation of the interviews, which adds a layer of interpretation to the analysis process of the data. Although the added layer comes from the transcriber, the digital audio recordings from all semi-structured interviews were transcribed verbatim, and the transcriber was asked not to indicate recorded pauses or intonation aspects. By providing an accurate written record of the spoken words from the audio recordings, subjectivity was minimised on the part of the transcriber. Omitting intonation aspects and pauses in the text would suggest that some of the meaning in the interviews would be lost. However, this loss of meaning was reduced to a minimum because the researcher read and listened to the digital recordings simultaneously.

Analysis of the interviews did not start after the transcription process, but rather started immediately at the beginning of the interviews by writing memos. Following the grounded theory guidance on coding (see sections 4.7 and 4.8), the researcher worked through each of the transcripts and used line-by-line coding to take note of themes and phenomena in the margins. The codes were not devised strictly microscopically, and some more abstract categories emerged; some codes were very close to the interviewees' accounts and others more abstract or conceptual. Memo writing turned out to be very useful in order to keep track of ideas, thoughts, suggestions and questions during the data collection and analysis process, which could then be sorted, categorised or discarded at a later point in time. The system of creating codes combined with the memos was maintained for coding all semi-structured interviews during the research process. The list of codes was revised continuously as more interviews were coded and were modified and verified by being applied to further interview transcripts. Subsequently, the codes were keyed into the Atlas.ti 7.0 CAQDAS to allow the researcher to search for and analyse the interviews and redefine the codes in order to support the analysis process.

4.11 Reflective reports

During the three semi-structured group interviews, the research participants were politely asked to write in a reflective way the answers to the questions which were part of the interview guide (see Appendix 5). The collection of data from the reflective reports therefore occurred

simultaneously with the semi-structured group interviews during the third phase of prototyping and evaluation. There was one important difference in that the teacher educators were asked to answer each question individually before the question would be discussed in the group interview. In this way, each participant had a chance to write down his or her own personal views, experiences or ideas concerning the questions without being directly influenced by the other group members. Participants were given sufficient time to answer each question.

The individual reflective reports were transcribed by the researcher into a Word processing file and were then analysed in ATLAS.ti. 7.0 following the grounded theory guidance on coding (see sections 4.7 and 4.8). The disadvantage of this process was that all hand-written reflective reports had to be transcribed into a Word file until it could be uploaded in a CAQDAS package such as ATLAS.ti 7.0. However, analysing and comparing the written answers with the answers from the interviews revealed how useful it is to choose mixed methods as this reduced bias and made it possible to corroborate the results from the semi-structured interviews and reflective reports which contributed to triangulation.

4.12 Summary

The critical discussion in this chapter focussed on three parts: 1) a critical reflection on the research methodology and the research methods, 2) a critical reflection on the coding processes and 3) a critical reflection on the data collection and data analysis processes of the different research methods. Because the aim of the research was to construct understanding from the data, grounded theory turned out to be a useful research approach when investigating teacher educators' technology learning. The use of mixed research methods, which entailed a combination of a quantitative method and several qualitative methods, generated a more accurate and adequate understanding of the social phenomena investigated in this research. Using a design-based research approach made it possible to contribute to the design of a TLP-instrument based on an iterative investigation. Following grounded theory guidance in which a threefold coding process was used as well of the use of memo writing throughout the research process helped to develop both understanding concerning the issues of technology professionalization.

Chapter 5:

Results and discussion: preliminary research phase

5.1 Introduction

This chapter integrates the quantitative data collected from the web-based questionnaire with the qualitative data collected from the semi-structured interviews, offering an explorative interpretation of the data. Although several arguments in the discussion have been based on either quantitative or qualitative data alone, the two strands have been combined, and are therefore in line with the principles of a mixed methods approach (Tashakkori & Teddlie, 2003; Greene, 2007; Creswell & Plano-Clark, 2011), as discussed in Chapters 3 and 4.

This chapter is organised into three main sections: (1) the presentation and discussion of the data collected from the web-based questionnaire; (2) the presentation and discussion of data collected from the semi-structured interviews, which led to the development of a prototype of a TLP-instrument which will be discussed further in Chapter 6, and (3) the conclusions and discussion section, which critically reflects upon the main findings of the preliminary research phase.

The aim of the preliminary design-based research phase (see Chapters 3 and 4) was to explore teacher educators' technology learning preferences, while a more comprehensive understanding was needed for the design and optimisation of the instrument. Based upon the literature discussion in Chapter 2, teacher educators' preferences for formal and informal, and collective and individual learning processes were further explored.

5.2 Data presentation of the web-based questionnaire

The preliminary research phase is part of the total iterative process of designing and developing adequate design requirements that can be used in the design and development of the prototype, which is why the web-based questionnaire was mainly used for exploratory purposes.

The first research question asks what kind of formal and informal technology learning activities and contexts teacher educators prefer to use as part of their technology

professionalisation. The second research question explores why they have preferences for particular individual and collective learning activities and contexts. To address both questions in an explorative way, a web-based questionnaire was used, which in its final form consisted of 34 questions based on the two identified learning dimensions as discussed in Chapter 2.

For the survey data, 179 teacher educators were recruited at a Dutch educational institution for teachers. Table 5.1 presents a detailed overview of the composition of the six teams. The sample group consisted of 51 men (49.5%) and 52 women (50.5%). The mean age of the sample group was 46 years (SD = 10.5). The mean for teaching experience was 19.8 years (SD = 11.2). With respect to their primary subject areas, the sample group consisted of 6 different interdisciplinary teams of teacher educators. Team A consisted of 13 physics, chemistry, science and technology teacher educators (n = 13 or 12.6%); Team B consisted of 22 geography, history and social science teacher educators (n = 22 or 21.4%); Team C consisted of English and German language teacher educators (n = 20 or 19.4%); Team D consisted of Dutch, Spanish and French language teacher educators (n = 12 or 11.7%); Team E consisted of biology, interactive skills and healthcare teacher educators (n = 15 or 14.6%); and Team F consisted of economics and math teacher educators (n = 21 or 20.4%).

Table 5.1 *Overview of the composition of teams (N = 103)*

Demo-graphics	**Team A**	**Team B**	**Team C**	**Team D**	**Team E**	**Team F**
Teacher educators	n = 13 (3 f. and 10 m.)	n = 22 (5 f. and 17 m.)	n = 20 (15 f. and 5 m.)	n = 12 (9 f. and 3 m.)	n = 15 (11 f. and 4 m.)	n = 21 (8 f. and 13 m.)
Subject area	physics, chemistry, and science and technology	geography, history, and social science	English and German	Dutch, Spanish, and French	biology, interactive skills, and healthcare	economics and math
Age	48.3 (7.1)	47.4 (9.5)	41.9 (11.9)	46.0 (12.3)	46.6 (10.1)	48.9 (9.6)
Teaching experience	19.6 (5.7)	22.9 (9.8)	16.9 (11.7)	20.9 (13.8)	17.2 (10.5)	21.4 (11.9)

Data is presented as f. (females), m. (males), M (mean), and SD (standard deviation)

The web-based questionnaire consisted of 34 questions, of which 5 questions focused on demographic aspects; 24 questions focused on teacher educators' preferences for formality

and collectivity in technology learning; one open question captured technology learning preferences in the workplace; and 4 questions focused on general contact information. The web-based questionnaire is to be found in Appendix 1. Table 5.2 shows the scores of all four preferred technology learning activities and contexts, and sample questions from the web-based questionnaire.

Table 5.2 *Overview scores for the four preferred technology learning situations (N = 103)*

Preferred learning situation	M	SD	questions	Sample question
Formal	2.25	1.23	3	I prefer to study a pre-established body of ICT knowledge and skills
Informal	4.31	0.93	3	Learning new ICT knowledge and skills is a process that lasts for an indefinite time and I prefer lifelong learning.
Individual	4.15	1.12	3	I prefer learning on my own initiative rather than directed learning.
Collective	3.49	0.97	3	Working together with colleagues in groups supports my learning process.

1 = disagree, 2 = slightly disagree, 3 = have no opinion, 4 = slightly agree, 5 = agree, M (mean), SD (standard deviation).

The first research question was addressed by examining the teacher educators' responses to the questions about formal and informal technology learning activities. The respondents were asked to indicate to what extent formal and informal learning activities were preferred in the workplace using a 5-point scale. Table 5.2 shows that respondents' preferred learning activities were mostly informal (mean 4.31 and SD 0.93). Formal learning activities received a low value (mean 2.25 and SD 1.23), which might indicate that teacher educators prefer informal learning activities over formal ones. This is in line with other studies (Cross, 2007; Timperley et al., 2008), as discussed in Chapter 2. However, the questionnaire responses do not clarify whether teacher educators simply did not prefer the learning activity itself or whether they did not prefer the entire formal learning approach. Teacher educators' low scores on formal learning may be influenced by their views on the efficiency of the formal learning activities derived from earlier formal learning experiences.

For questions 21, 27 and 29, respondents were asked to indicate whether they preferred specific formal learning activities or contexts for learning ICT knowledge and skills. Teacher educators indicated that the prospect of receiving a certificate or diploma at the end of a course or workshop is not a strong incentive to increase their motivation to learn, as shown in Table 5.3. Question 29 shows that summative testing is considered to be less relevant for learning ICT knowledge and skills (M = 3.54). Question 27 revealed an unexpected score. Table 5.3 shows that teacher educators valued the guidance of an expert while learning ICT knowledge and skills, which generated a new point to reflect on. Because more than 40% of the respondents disagreed with this statement, it may be that the teacher educators value the presence of a skilled or knowledgeable person who can provide them with assistance while learning new ICT knowledge and skills. A more in-depth investigation of the situations in which teacher educators prefer more formal learning methods would be useful.

Table 5.3. *Overview of the value scores for formal learning (Questions 21, 27, and 29)*

Question 21: Receiving a certificate at the end of a course motivates me.

1 disagree	**2** slightly disagree	**3** neutral	**4** slightly agree	**5** agree	**N**	**M**
40 (38.4%)	25 (24.3%)	16 (15.5%)	16 (15.5%)	6 (5.8%)	**103**	**2.15**

Question 27: I prefer learning ICT knowledge and skills without the guidance of an expert.

1 disagree	**2** slightly disagree	**3** neutral	**4** slightly agree	**5** agree	**N**	**M**
41 (40.2%)	30 (29.4%)	21 (20.5%)	7 (6.8%)	3 (2.9%)	**103**	**2.03**

Question 29: I prefer the absence of a summative test at the end of the learning process.

1 disagree	**2** slightly disagree	**3** neutral	**4** slightly agree	**5** agree	**N**	**M**
13 (12.6%)	6 (5.8%)	30 (29.1%)	20 (19.4%)	**34 (33.0%)**	**103**	**3.54**

N = number of respondents, M = mean

To address the second research question, the responses about individual and collective learning activities were closely examined. As Table 5.2 shows, teacher educators generally prefer individual learning activities (mean 4.15 and SD 1.12). Although collective learning

received a lower value (mean 3.49 and SD 0.97), differences between the mean scores of both preferred learning activities are smaller than the mean scores for formal and informal learning activities.

An inspection of the value distribution of the responses to questions 17 and 19 revealed teacher educators' preferences for collective learning while learning new ICT knowledge and skills (see Table 5.4). These results are in line with the results of previous findings (Putnam & Borko, 2000; Butler et al., 2004; Shank, 2006) which show that collective learning is a useful means for exchanging ideas, beliefs and experiences among teachers while learning new technology knowledge and skills. The somewhat higher mean score for individual learning than collective learning may relate to respondents' experiences of collective learning activities that do not always correspond with individual learning needs. Further investigation is required to yield more detailed insights into this issue.

Table 5.4. *Overview of the value scores for collective learning (Questions 17 and 19)*

Question 17: Working together with colleagues in groups supports my learning process.

1 disagree	**2** slightly disagree	**3** neutral	**4** slightly agree	**5** agree	**N**	**M**
21 (20.4%)	13 (12.6%)	14 (13.6%)	**40 (38.8%)**	15 (14.6%)	**103**	**3.15**

Question 19: While working together in team activities, I prefer to consult colleagues who are more ICT knowledgeable and skilled.

1 disagree	**2** slightly disagree	**3** neutral	**4** slightly agree	**5** agree	**N**	**M**
2 (2.0%)	6 (5.9%)	5 (4.9%)	**50 (49.0%)**	39 (38.2%)	**103**	**4.16**

N = number of respondents, M = mean

Arguably, the results of the web-based questionnaire indicate that teacher educators prefer informal technology learning activities. Because of the limited number of questions on formal and informal learning, it would be premature, however, to conclude that informal learning is preferred over formal learning. The question which remains to be answered is why teacher educators prefer the guidance of an expert while learning new ICT knowledge and skills, whereas informal learning activities (see Tables 5.2 and 5.3) are preferred over formal learning activities. This result seems to contradict the findings of studies in which formal learning

methods are less valued (Lohman, 2006; Tynjälä, 2008). One explanation might be that the guidance of an expert meets the individual learner's needs in relation to his or her teaching practice. This suggestion is in line with studies about professionalisation programmes (Garet et al., 2001; Wiske, 2006), as discussed in Chapter 2, which claim that teacher educators "want different kinds of assistance and support, depending on their own goals and concerns" (Wiske, 2006: 36). Another possible explanation can be found in this study's data collection method, in that the use of a web-based questionnaire for the preliminary research phase limited the access to more detailed data. Use of an additional data collection method such as semi-structured interviews might result in different findings which contribute to a better understanding of this issue. Following the analyses of the data from the web-based questionnaire, teacher educators' preferred learning methods were gleaned from the open question in the web-based questionnaire.

5.2.1 Statements about preferred technology learning modes

To more closely examine the four preferred technology learning activities and contexts in the workplace, teacher educators who participated in the web-based questionnaire were asked to respond to the following open question: *I prefer to study ICT knowledge and skills …* This question was intended to encourage the respondents to state what they felt to be appropriate with regard to their learning of ICT knowledge and skills. Of the 103 total respondents who completed the web-based questionnaire, 79 teacher educators responded to the question. Informed by a grounded theory approach, as discussed in Chapter 3, analysis of the data produced a list of four combined learning modes, shown in Table 5.5. There is a significant difference in preferred learning activities that are based on a single technology learning mode or combined technology learning modes, which generates a new point to reflect on. The data from the open question suggests that the combination of different learning methods can be seen as complementary modes of learning and may cater to the individual's learning preferences. It would therefore be interesting to gain a better understanding of why teacher educators consider these combined learning modes as useful.

Table 5.5. *Illustrative responses from teacher educators (question 30: I prefer to study ICT knowledge and skills …)*

Number of responses	Example responses
Formal learning n = 3	1. Together with experts and receiving an overview of using ICT 2. In a quick, and effective way, and within a predefined curriculum
Informal learning n = 5	1. That is contextualised and relevant 2. When it is just-in-time learning
Individual learning n = 16	1. Independently. Learning only those skills which I need. So, only based on my own learning need 2. When learning is based on my own initiative and my own learning needs
Collective learning n = 11	1. Together with others using a computer or Smart Board 2. Together with other colleagues and focussing on quick results
Individual-formal learning n = 12	1. Together with an expert based on a personal learning goal 2. When it suits me with the guidance of an expert
Individual-informal learning n = 8	1. Based on a problem which I encountered in practice at a moment when I have the time for it 2. When I encounter a personal problem
Collective-formal learning n = 10	1. First with colleagues following a workshop and after that receiving support on demand 2. In small groups together with an expert
Collective-informal learning n = 2	1. When it is demand-driven, in small groups 2. When there are no set learning goals but together with colleagues
Other responses n = 12	1. Along the road 2. By trying it

Note: Quotes have been freely translated. The meaning of the Dutch version has been preserved.

Figure 5.1 illustrates that, as separate learning modes, informal and formal learning are less valued. Analysis of the data, however, suggests that informal and formal learning methods combined with individual or collective methods are more valued. This result can be explained by learners' preference for learning informally while still placing value on an expert's instructions and guidance during the learning process. Connecting formal technology learning methods with informal ways of acquiring new ICT knowledge and skills seems to contribute to teacher educators' meaningful learning.

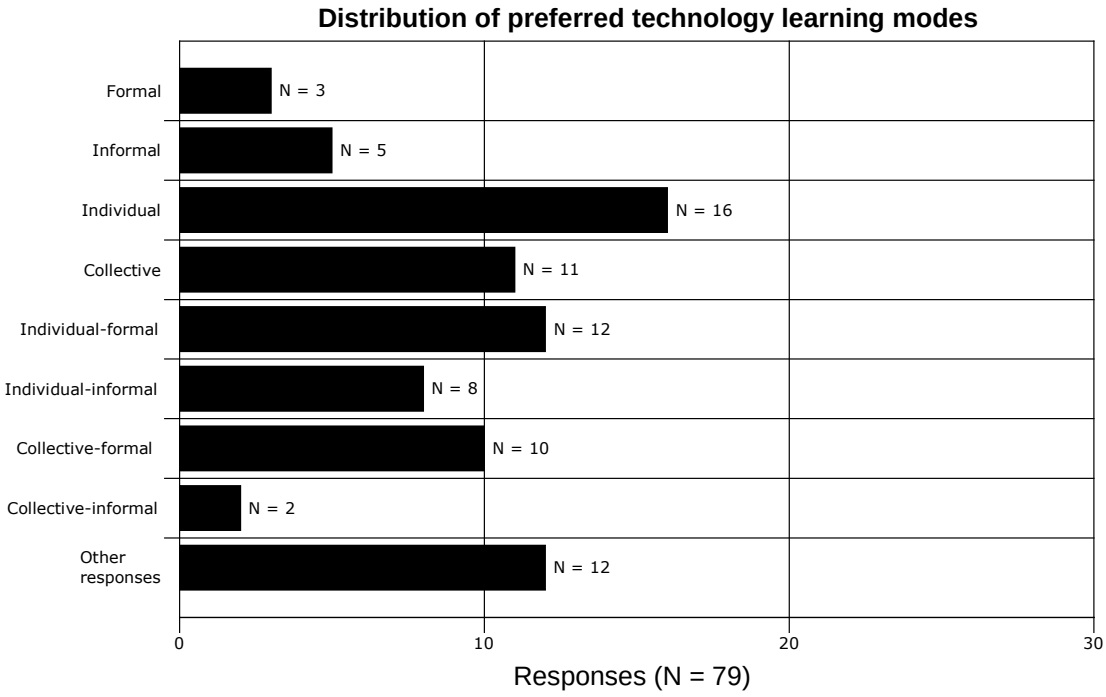


Figure 5.1. *Distribution bar chart of the preferred technology learning modes*

Analysing the teacher educators' statements about their preferred learning activities in connection with the results of the web-based survey revealed a main strand that emerged from coding the data. The main strand focuses on teacher educators' preferences for combined technology learning modes. Based on this main strand four important findings could be identified.

Finding 1: Teacher educators place less value on formal learning

Based on the analysis of the data from the closed-ended questions in the web-based questionnaire, teacher educators do not strongly value formal learning while acquiring new technology knowledge and skills. A brief look at Table 5.2 reveals that, in general, most respondents did not prefer formal learning activities (mean 2.25 and SD 1.23). Although there was a small number of questions about preferred formal learning activities, the answers to questions 21 and 27 (Table 5.2) indicate that informal learning is preferred over formal learning. Examining the data from the web-based questionnaire with regard to preferred formal learning activities revealed that only three respondents indicated that they valued formal technology

learning activities. An explanation for this result may be that teacher educators do not value formal learning since they do not initiate the formal learning activities in the workplace, and therefore may not contribute to their own technology professional development.

Finding 2: Preference for collective learning

Table 5.2 shows that teacher educators value performing technology learning activities with other colleagues, as revealed in question 17 (Table 5.5): almost 40% of the respondents valued the process of collaborating and interacting in groups with other colleagues. It seems that the social interactions with colleagues in the workplace contribute to the technology learning process. This finding is in line with studies (Sloep & Jochems, 2007) discussed in Chapter 2. Question 19 reports the teacher educators' learning preferences with regard to consulting colleagues who have more ICT knowledge and skills: 49% of the respondents indicated that they prefer collegiate consulting. However, a point for discussion is that teacher educators do not value the combined learning mode of collective-informal learning whereas they prefer both single learning modes much more.

Finding 3: Preference for the combined learning mode of individual-formal learning

Few teacher educators preferred formal learning as a single learning mode. However, analysis of the data from the open question (see Table 5.5 and Figure 5.1), revealed that teacher educators strongly valued the combined learning mode of individual-formal learning. As noted earlier, this may be explained by teacher educators' preference for learning activities that they initiate and that contribute to their personal learning needs. These preferences with regard to formal learning may be rooted in teacher educators' preference for short instructional periods which meet their learning needs.

Finding 4: Preference for the combined learning mode of collective-formal learning

As shown in Table 5.5, ten teacher educators indicated that they prefer combined collective-formal learning activities. The preference for this type of combined learning is inversely related to the reported statements about preferred formal learning activities. The respondents valued the process of collective learning while having pre-set learning goals or an ICT expert to

consult. Teacher educators' descriptions of their ICT-learning experiences involving colleagues were generally positive (see Tables 5.4 and 5.5).

The overview of scores with regard to preferred learning preferences as presented in Table 5.2 provided insight into how teacher educators valued different technology learning methods when learning new ICT knowledge and skills. The results yielded information that could be used in the subsequent research phase. An important finding, prevalent in the analyses, was that teacher educators reported that they did not value formal learning as a single learning mode, whereas they valued a combined learning mode consisting of formal and collective learning activities. One explanation is that adopting this approach allows teacher educators to share problems or experiences with colleagues by collectively reflecting upon their experiences and receiving immediate feedback from other colleagues and an expert. During the qualitative step of the preliminary research phase, the intention was to use the qualitative results to design specific questions to explain the quantitative results regarding the single and combined preferred learning activities.

5.3 Data presentation of semi-structured interviews

As discussed earlier, the analysis of the web-based questionnaire results revealed a main strand that emerged from coding the data and indicated that teacher educators have a preference for combined learning modes: references to individual-formal and collective-formal technology learning activities were more prominent than formal learning as a single learning mode.

As discussed in Chapters 3 and 4, to gain greater insight into the different preferences for learning activities, the web-based questionnaire results were used to inform the development of the semi-structured interviews to further explore the main strand that focuses on teacher educators' preferences for combined technology learning modes. The semi-structured interviews consisted of general questions about technology professionalisation, and questions about teacher educators' preferred technology learning in the workplace. The semi-structured interview script is to be found in Appendix 2.

The semi-structured interview data revealed that none of the respondents indicated that they preferred a specific learning activity. The analysis of the results suggested that the teacher

educators preferred technology learning activities based on the context and their own learning needs. These findings are in line with the research of Cordingley et al. (2003), Timperley et al. (2008), and Darling-Hammond (2010), who also found that professional development programmes are more effective when they meet teacher educators' personal learning needs. An example from the data supports this finding:

> "Informal learning moments are far more important than having formal learning moments for ICT. Because it is very needs-based and just-in-time … and the formal setting does not work."
>
> (semi-structured interview, Interviewee KC-01Prelim12)

In this example, the interviewee clearly stated that in his/her experience, traditional, formal courses and workshops do not suit her learning needs. Learning preferences seem to be based on personal objectives for the topic being addressed, which suggests a point to reflect on. Although teacher educators indicated that they do not value single formal learning activities, they did value individual-formal learning activities. A possible explanation for this is that teacher educators prefer to be in control of their own learning process, but they value the assistance of an expert at particular moments, as shown in this example:

> "I think it is useful to have an expert or instructor available … someone who can help you whenever help is needed. Sometimes … I think that it works better when you start with an introduction by an expert … but I like to be in charge of my own learning … so this should not be the norm, which is quite often the case."
>
> (semi-structured interview, Interviewee GA-01Prelim12)

Another educator confirmed that in traditional professionalisation programmes, insufficient attention is paid to individual learning needs, as this example shows:

> "I do not like those pre-set objectives, too fixed and too general, … and it goes too fast. Not everybody learns these types of things such as ICT that easily. I like it when there is

an instructor or expert who helps me. But in general I prefer to choose my own way of learning."

(semi-structured interview, Interviewee HR-01Prelim12)

Further analysis of the data revealed that teacher educators' learning preferences are directly linked with their motivation to learn ICT knowledge and skills that are relevant to their own teaching and learning contexts. Some examples are:

"I think I would be able to probably produce more interesting lessons. I can certainly relate more with their ideas [students' ideas], their world, because they live in this computer world where I only understand half of the jargon, if I am lucky. Anything to do with new technical things including the Smart Board would be a great help to me, it would also give me more confidence to stand in front of the class."

(semi-structured interview, Interviewee KC-01Prelim12)

"A colleague of mine, who used to work at a secondary school and who has been a teacher educator now for four years … has a lot of experience in using Smart Boards. I once had a chat with him about how to use the Smart Board. Technically, I know how to use it … but the advice he gave me made me more confident in how to use the Smart Board in the classroom … These informal moments give me more confidence to make use of this tool in my own classroom."

(semi-structured interview, Interviewee GA-01Prelim12)

After exploring the data for examples of single learning preferences, analysis revealed examples of combined methods for technology learning (see Table 5.6). These results correspond with the responses to the open question in the web-based questionnaire (see Table 5.5). An example is:

> "If it is informal it is just colleagues … [in] that sort of informal way there is always somebody there who says 'you could do this or that', which is such a valuable thing. It is not just having people who know or a team that works together and helps each other that is something that I really appreciate."
>
> (semi-structured interview, Interviewee HR-01Prelim12)

As discussed in Chapter 2, learning can and does occur when learners are engrossed in an activity that they find interesting, but in order for teacher educators' technology learning to be more than a fortunate by-product, varied learning methods must be included in a professionalisation process that is personally relevant to them. Developing a successful learning environment means providing different learning opportunities.

Table 5.6 *Teacher educators' sample quotes from the semi-structured interviews indicating their technology learning preferences*

Teacher educator	Sample quotes	Learning preferences
GA-01	Those objectives, as you mention them, which are in a course, those are course learning goals which are set up by the course provider and they are learning goals which help me to succeed. These help me to get going and to find the right direction.	Formal
KC-01	It is far more important than having formal learning moments … for ICT. Because formal learning is more needs-based than the formal learning which does not work. I do not think … that at the moment … we are choosing a formal course. So informal learning is important. Yes!	Informal
GA-01	No, I am too individualistic. I like to get something from people but I am not looking for a partner along the way, if I may describe it like that.	Individual
RB-01	No, I am very much a collective learner, especially ... regarding IT, it is helpful to have somebody struggling along with me, or somebody who says, ooh you have to do that, ... like this.	Collective
BT-01	I do think that pre-set learning objectives are good to start with and I do think that learning in groups is a good thing because we can exchange ideas and experiences.	Collective-Formal
SR-01	It depends on the program and the difficulties. If it is quite a difficult program and I do not understand the background of a program … software, then I do like to have a course that fits my personal learning wish.	Individual-Formal
HR-01	If it is informal and it is just colleagues. While learning together with colleagues … that is such a valuable thing.	Collective-Informal
KC-01	My idea would be that I would prefer individual learning in informal learning contexts.	Individual-Informal

Note: Quotes have been freely translated. The meaning of the original Dutch version has been preserved.

5.4 Proposed concept model based on the results

The analysis of the data collected through the web-based questionnaire, and the fragments from the semi-structured interviews revealed a main strand that emerged from coding the data which focuses on teacher educators' preferences for combined technology learning modes. The insights which emerged during the preliminary research phase, were used to develop a concept model (Figure 5.2) concerning technology learning preferences, leading to the development of a prototype instrument discussed in Chapter 6. The investigation of the preliminary research phase will be used to draw a clearer picture of teacher educators' technology learning preferences, which characterise the four learning modes combining formal, informal, individual and collective learning. With these preferred learning modes to serve as an outline of teacher educators' technology learning in the workplace, the next chapter will examine possible refinements for a prototype instrument based on the concept model. This concept model postulates the existence of two primary learning dimensions, as discussed in Chapter 2, and four combined technology learning modes that emerged from the coding process during the preliminary research phase.

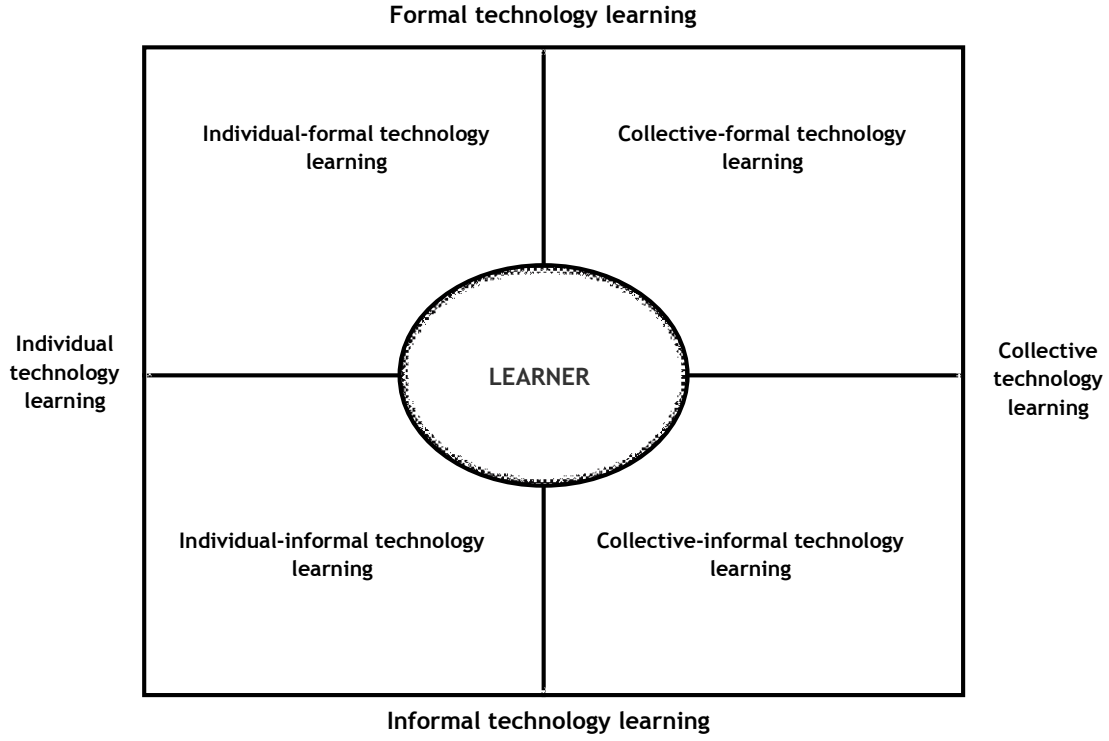


Figure 5.2 *Concept model of preferred technology learning modes*

Based on the results of the preliminary research phase, the four combined technology learning modes are defined as follows:

(IF). A preference for the combined learning mode of individual-formal, encompassing a focus on learning activities in which teacher educators can build technology knowledge and skills based on personal learning needs. When learning new ICT knowledge and skills, teacher educators value formal learning aspects, such as pre-set learning objectives or the presence of an expert.

(CF). A preference for the combined learning mode of collective-formal, focussing on learning activities in which teacher educators construct technology knowledge and skills based on their personal learning needs through social interaction with colleagues. When learning new ICT knowledge and skills, teacher educators value formal learning aspects, such as pre-set learning objectives or the presence of an expert.

(II). A preference for the combined learning mode of individual-informal, including learning activities in which teacher educators build technology knowledge and skills based on their personal learning needs. When learning new ICT knowledge and skills, teacher educators value informal learning aspects, such as authentic learning situations, self-paced and open-ended time allocation, and the absence of pre-set learning objectives.

(CI). A preference for the combined learning mode of collective-informal, centred on learning activities in which teacher educators construct technology knowledge and skills based on their personal learning needs through social interaction with colleagues. When learning new ICT knowledge and skills, teacher educators value informal learning aspects, such as authentic learning situations, self-paced and open-ended time allocation, and the absence of pre-set learning objectives.

5.5 Conclusions and discussion

The aim of the preliminary research phase was to explore teacher educators' preferences for formal, informal, individual and collective technology learning methods. To gain insight into these preferred learning methods, quantitative and qualitative research techniques were used. First, the general preferences of 103 teacher educators were examined for four main types of technology learning activities, as discussed in Chapter 2, using a web-based questionnaire. Second, teacher educators' statements, based on eleven semi-structured interviews, were analysed and compared with the results of the questionnaire.

Examination of the mean scores on the web-based questionnaire showed a general preference for informal learning methods. The respondents also showed a preference for two other learning methods; namely, individual and collective learning. Formal technology learning was least preferred. The results concerning teacher educators' preferred single learning modes correspond to the findings of several studies (Kwakman, 2003; Eraut, 2004;, 2009, Zhao & Kuh, 2004; Sharan, 2007; Lohman 2009) as discussed in Chapter 2. However, the results of the open question in the web-based questionnaire raised a number of issues. Although respondents had the lowest preference for formal learning as a single learning mode, the results indicated that if formal learning is combined with individual learning activities, it is more valued. Possible explanations are that teacher educators need specific instructions at certain moments or that the number of questions in the questionnaire was too small to obtain an adequate picture of the respondents' preferences, although they could have expressed their learning preferences in the open question (question 30). Another possibility is that respondents interpreted the formulation of the question differently. Some teacher educators might have interpreted individual technology learning activities and formal technology learning activities differently. In sum, the results as measured in the questionnaire probably do not provide a full understanding of teacher educators' preferred technology learning methods in the workplace.

To gain more insight into why teacher educators preferred particular technology learning methods, the statements from the semi-structured interviews were closely analysed. Findings from both data collection instruments indicated that the respondents do not value single learning modes but prefer combined learning modes which emerged from the data as a main strand. To be more specific, respondents indicated that they do not value single formal learning methods.

A comparison of findings from both data collection instruments indicated that teacher educators frequently prefer combined technology learning methods in the workplace. The insights that were gained during the preliminary research phase discussed in this chapter and the literature review in Chapter 2 were used to inform the design and development of a TLP-instrument which will be discussed in Chapter 6.

Chapter 6:

Results and discussion of prototyping and evaluation phases

6.1 Introduction

This chapter consists of three parts: the first is a discussion of the main activities concerning the design and evaluation of the first prototype. The second is the presentation and discussion of the data collected from the semi-structured interviews which was used to develop the second prototype. The third part presents the data from the reflective reports and semi-structured group interviews, which were used to refine and evaluate the third prototype.

In Chapter 5 the quantitative data collected from the web-based questionnaire and the qualitative data collected from the semi-structured interviews were examined and used to develop a concept model (see Figure 5.2) concerning teacher educators' technology learning preferences. To address Research Question 4, 'How can a continuing technology learning preferences instrument be designed for technology professionalisation based on teacher educators' preferences regarding the level of formality and the degree of collectivity in their learning process?' the concept model based on the four combined learning modes that emerged as a main strand from coding the data during the preliminary research phase was used to design and develop a prototype instrument.

In the following section, the design and development process of the questionnaire as part of the TLP-instrument will be discussed in addition to the results based on the expert reviews.

6.2 Introduction to the design and evaluation of the TLP-instrument

Through the research, collection and analysis of data the following three design principles informed the design of the prototype instrument: 1) the instrument should be brief and straightforward, making it useful in support of teacher educators' technology learning preferences; 2) the instrument should map teacher educators' technology learning preferences based on the four learning modes as presented in Figure 5.2; 3) the instrument should provide

more insight into technology learning activities, factors and strategies that contribute to teacher educators' technology learning. Before presenting and discussing the results of each prototype phase in more detail, a short discussion about the design of the TLP-instrument for each phase will be presented.

Prototype phase I: Design of the TLP-instrument and expert evaluation

Based on the literature review discussed in Chapter 2, and the results from the preliminary research phase discussed in Chapter 5, 48 questions were formulated for the questionnaire. For each learning mode, 12 questions were selected. This stage involved five experts (see 6.3.1), who are all scholars in the field of teacher educators' professional development and who have experience in evaluating questionnaires. The five experts provided review evaluations, and their recommendations were used for subsequent modification of the TLP-questionnaire during prototype phases II and III. At this stage, the prototype instrument consisted of a questionnaire alone.

Prototype Phase II: Refinement and first evaluation of the TLP-instrument

This research phase involved the refinement of the TLP-questionnaire and further development of the TLP-instrument designed to support teacher educators in mapping their technology learning preferences. The underlying structure of the prototype instrument was based on the results and recommendations of the expert reviewers during prototype phase I. The second prototype of the TLP-instrument took the form of a questionnaire which consisted of 40 questions, 10 questions for each technology learning mode. The order of the 40 questions in the TLP-questionnaire was randomised. The second part of the TLP-instrument consisted of a scorecard and a graph used to plot the data points from the individual learning preferences scores which were based on the TLP-questionnaire scores. The Dutch version of the TLP-instrument can be found in Appendix 6 and an English version is to be found in Appendix 7. The scorecard and graph were tested out among the five teacher educators who participated in the semi-structured interviews. The instrument was provided to the interviewees before the semi-structured interviews were conducted.

Prototype Phase III: Refinement and further evaluation of the TLP-instrument

The third stage of the design and development of the prototype involved the further refinement and evaluation of the TLP-instrument based on the results and recommendations of the teacher educators who participated in the five interviews during prototype phase II. The TLP-instrument consisted of 40 questions, some of which had been refined for better wording, with 10 questions for each technology learning mode. The order of the 40 questions in the TLP-questionnaire was randomised. The data collected from the reflective reports and semi-structured group interviews were used to finalise the TLP-instrument.

6.3 Design and evaluation activities of Prototype I

The primary purpose of the TLP-instrument is to provide teacher educators with information about their preferred technology learning methods and activities. The instrument defines technology learning not as a fixed trait, but as a dynamic state based on teacher educators' changing technology learning needs. This corresponds with Kolb and Kolb's approach to learning wherein a learning style is seen as "a dynamic state arising from an individual's preferential resolution," which does not derive "solely from fixed genetic qualities or characteristics … nor does it come from stable fixed demands of environmental circumstances" (2005: 10). Sample questions for the questionnaire are shown in Table 6.1.

Table 6.1 *Sample questions from the questionnaire as part of the TLP-instrument*

Learning mode	Sample questions
Formal technology learning	• *I prefer to acquire ICT knowledge and skills that lead to a certificate.* • *I prefer to acquire ICT knowledge and skills with the guidance of an expert.*
Informal technology learning	• *I prefer to acquire ICT knowledge and skills that are part of a spontaneous learning process.* • *I prefer to acquire ICT knowledge and skills that takes place unnoticed*
Individual technology learning	• *I prefer to acquire ICT knowledge and skills by defining my own learning goals.* • *I prefer to acquire ICT knowledge and skills through self-reflecting on learning experiences.*
Collective technology learning	• *I prefer to acquire ICT knowledge in a group.* • *I prefer to acquire ICT knowledge and skills while working together on shared tasks.*

Note: Questions have been freely translated. The meaning of the original Dutch version has been preserved.

Evaluation of the questionnaire as part of the TLP-instrument was further established through a discussion with teacher educators during Prototype Phases II and III. This was done to assess whether the questions for each technology learning mode and response options using a five-point scale ranging from *strongly disagree* to *strongly agree* were recognisable for teacher educators. Table 6.2 presents a sample question with a five-point scale.

Table 6.2 *Example question of questionnaire along a five-point scale*

I prefer to acquire …	**strongly disagree**	**disagree**	**undecided**	**agree**	**strongly agree**
… ICT knowledge and skills based on an unstructured learning process.	O	O	O	O	O

To determine the total score for each learning mode per participant, participants were asked to add up the scores from all questions that constituted each learning mode. Questions that were answered *agree* counted for one point and questions that were answered *strongly agree* received two points. Table 6.3 presents part of the scorecard which was used to add the scores as data points to a graph as shown in Figure 6.1. The entire scorecard is to be found in Appendix 6.

Table 6.3 *Sample scorecard for each technology learning mode.*

Question number Formal technology learning	**Question number Collective technology learning**	**Question number Informal technology learning**	**Question number Individual technology learning**
1. 6. 12.	4. 7. 10.	3. 8. 11.	2. 5. 9.
Total 1:	**Total 2:**	**Total 3:**	**Total 4:**

The following sections discuss the method of pretesting the TLP-questionnaire by consulting a panel of expert reviewers. Possible problems and suggestions concerning clarity, brevity, wording of the questions and construct aspects are discussed in terms of the refining and redesigning of Prototypes II and III.

6.3.1 Formative evaluation by expert panel reviewers

During the design and development of the TLP-instrument, formative evaluation was an integral part of the design methodology, as discussed in Chapter 3. The formative evaluation was based on the experts' feedback on the strengths and weaknesses of the TLP-questionnaire during Phase I of the prototyping, for the purpose of refining it (McKenney & Reeves, 2012). As the main purpose of formative evaluation is to collect the relevant data for revisions and improvements, expert reviewers were asked to identify potential problems.

The purpose of using reviews at this stage was to gain informed perspectives from valued experts who were all scholars in the area of professional development and who had years of experience in questionnaire design and survey research. Three of the reviewers were employed at the same teacher education institution; two reviewers were employed at two research universities in Belgium and the Netherlands. Although three of the reviewers belonged to the same organisation as the researcher, the three experts were not involved in any aspect of this research other than providing reviews of the questionnaire. The reviewers were selected because they all had similar training on survey methodology, and they had expertise in the field of teacher educators' professionalisation programmes. In this way, the potential effects of any variation in the reviewers' background on the questionnaire review process could be minimised, rather than using a probability sample of all experts which is in line with Olson (2010).

To maintain the independence of the reviews, the experts conducted the reviews individually. All five experts received a list of the 48 questions that were part of the prototype, and they were asked to identify problems based on two review categories. The first review category focussed on the three aspects of clarity, brevity and wording of the questions (Larossi, 2006; Faux, 2010). The second review category focussed on the content to determine domain or construct problems. The experts reported their reviews digitally (as Microsoft Word files) that were provided for them. An overview of the questions that were used by the experts to review the questionnaire questions is to be found in Appendix 4.

6.3.2 Results of expert evaluation

Although examination of the data from the expert reviews revealed substantial disagreement about which questions had potential problems in the two review categories, analysis of the data

made clear that the disparities among the experts' answers were due to each reviewer's identification of a specific problem at different points in the questionnaire.

There was some consensus among the five evaluators about whether the questionnaire questions corresponded to the specific learning domain. They indicated that the questions generally fulfilled aspects of the specific learning domain, but several questions were identified as potentially posing problems for respondents. Confusion among the five experts seemed to stem from the generic wording of the questions. For example, one expert mentioned that "it was confusing that most questions were about acquiring ICT knowledge and skills but some were not" (Expert A).

The analysis of the data from the expert reviewers helped in identifying a revised set of 40 questions for further development and evaluation during Prototype Phase II and Prototype Phase III. Additionally, the data provided insights into questionnaire formatting, information treatments, and construct aspects. Based on the potential problems, three recommendations were formulated to develop revised questions and refine the TLP-instrument during the second prototype phase:

Recommendation 1: Simplifying complex questions

Several questions were identified as too complex because undefined terminology or jargon was used. To effectively address the potential problems, the questions would need to be deconstructed.

Recommendation 2: Concepts are not always clear

The reviewers indicated that several questions which belonged to different learning modes consisted of the same conceptual elements, indicating that there were more sub-scales within one scale. The suggestion was made to examine questions more thoroughly to address the overlap in learning modes. Returning to the literature discussed in Chapter 2 and using the feedback from the reviewers contributed to the revision process of the TLP-questionnaire.

Recommendation 3: Number of points and verbal labels on rating scales

A general issue mentioned by the reviewers was the number of points on the rating scale. The rating scale that was used in the questionnaire under review consisted of a 4-point scale with

only two verbal labels on both ends of the scale. Suggestions were made to include verbal labels on all points of the scale which could enhance the uniformity of interpretations. Additionally, the experts suggested increasing the number of points on the scale: four of them suggested a 5-point or 7-point Likert scale. Initially, the idea was to design a 4-point Likert scale questionnaire because this would prevent participants from choosing a neutral position. The reviewers suggested using a 5-point Likert scale because adding midpoints to the rating scales might decrease measurement error, as shown in studies on the use of Likert scales in questionnaires (Dawes, 2008; Norman, 2010). The results from Prototype Phase I provided valuable recommendations that were used to refine and redesign the TLP-instrument in the second phase.

6.4 Data presentation of Prototype II

As discussed in Chapter 1, Research Questions 1 and 2 consisted of two parts: (a) What kinds of technology learning do teacher educators prefer in current learning contexts? and (b) What kinds of technology learning activities do they prefer? The following two sections will present and analyse both parts of the research questions.

To gain more insight into teacher educators' technology learning preferences, five teacher educators from a teacher education institution completed the TLP-questionnaire before they participated in an individual semi-structured interview. The semi-structured interview script is to be found in Appendix 5.

The primary purpose of the TLP-instrument is to provide teacher educators with information about their preferred technology learning, and therefore the outcomes of the TLP-questionnaire were used to inform the discussion in the semi-structured interviews about the teacher educators' individual preferences for the four technology learning modes. As Figure 6.1 illustrates, the TLP-scores indicated that teacher educators preferred combined learning modes. This corresponds to the main strand that emerged from coding the data during the preliminary research phase which revealed teacher educators' strong preference for combining different technology learning modes.

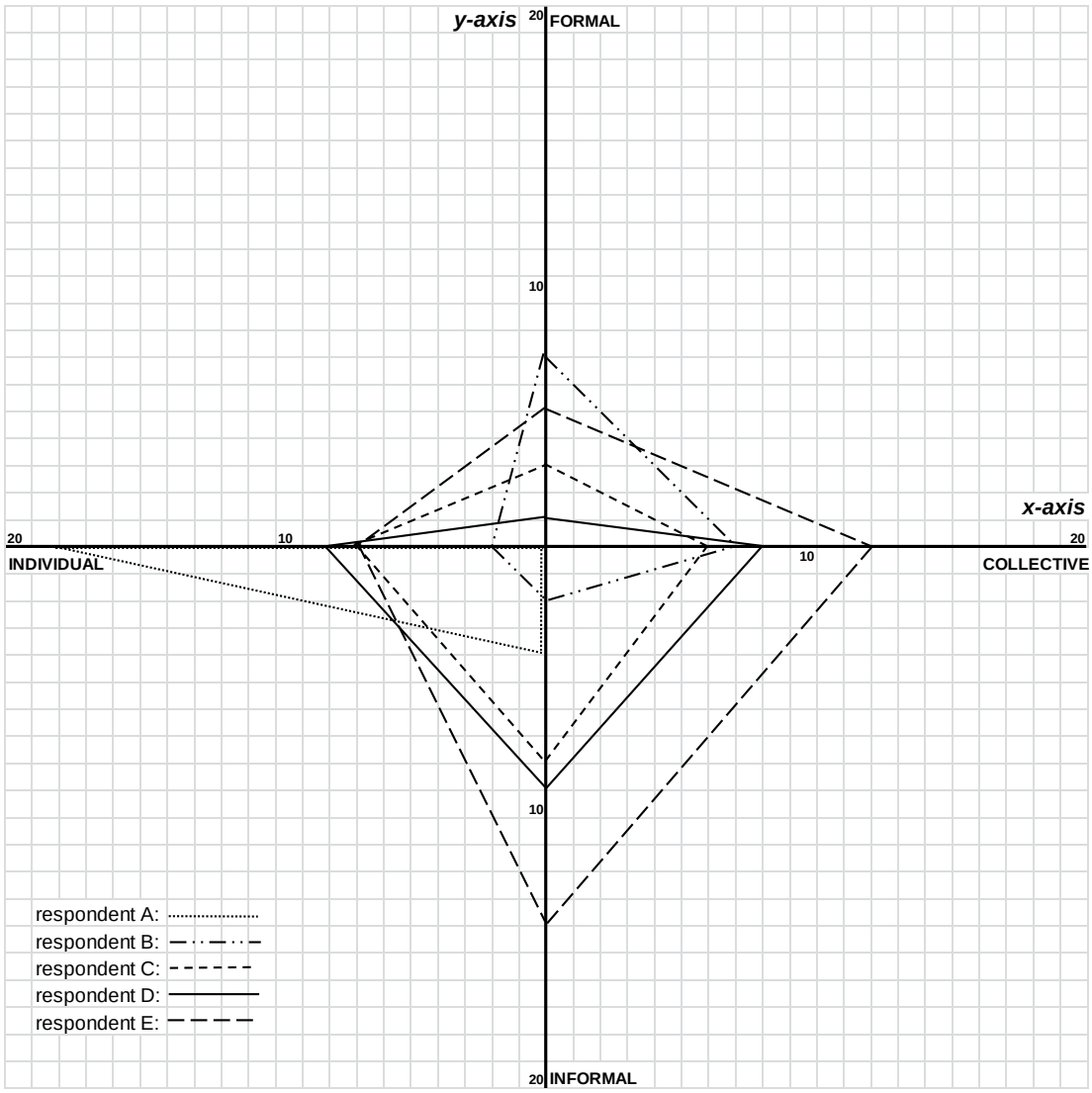


Figure 6.1 *Overview of the preferred technology learning scores*

Informal technology learning preferences were more prominent than formal ones. The scores reveal that four teacher educators valued formal technology learning, but the individual TLP-scores suggest that five participants valued informal learning activities over formal ones. Only one teacher educator indicated a strong preference for individual ways of learning and related activities. Although the data in this section correspond to the data in Chapter 5, the main difference is that the TLP-instrument provides more insights into teacher educators' individual technology learning preferences. Additionally, the TLP-instrument was designed and constructed as a self-assessment instrument to map teacher educators' preferred technology learning preferences, and thus using the instrument is intended to increase participants' awareness and understanding of how they prefer to learn.

6.4.1 Data presentation from the semi-structured interviews about the use of the TLP-instrument.

To examine in more depth the ways in which the TLP-instrument benefited teacher educators, five semi-structured interviews were carried out with five participants who were asked to respond to the following question: 'In what way was the TLP-instrument helpful to you?' Four respondents felt that the questionnaire helped them to reflect on their technology learning preferences related to their learning needs.

Based on the analysis of the data from the semi-structured interviews, informed by the grounded theory approach discussed in Chapters 3 and 4, a second main strand that focuses on the utility of the instrument emerged from coding the data. Four categories about how the TLP-instrument supported the teacher educators in their learning could be defined as follows: 1) an enhanced awareness of preferred technology learning modes, that is, being more conscious of the kinds of technology learning one prefers; 2) a better understanding of preferred technology learning modes, which refers to the ability to perceive one's learning preferences; 3) more insight into preferred technology learning modes, or the capacity to understand why specific technology learning is favoured in a given learning context; and 4) increased discussion of the preferred technology learning preferences, which applies to the TLP-instrument as a means to foster conversation with other teacher educators, managers, and professional development providers to design and develop an effective learning process that meets the learners' needs. Table 6.4 lists a sample statement for each of the four categories.

Table 6.4 *Sample quotations about the use of the TLP-instrument.*

categories	sample quotations
Awareness	"… filling in the questionnaire made me aware of the fact that the preferred learning modes and activities depend on the learning situation."
Understanding	"… I think that using two axes in the graph is an added value … it makes it possible to visualise my own technology learning preferences in a better way. It is now easier for me to choose useful activities"
Insight	"…The questions in the questionnaire clearly direct me into a certain preferred way of ICT learning. In other words, It gives me insight into how I like to learn now but in other situations this could be different."
Foster conversation	"… I do think that the questionnaire is a good start to have a conversation with my manager or team leader."

Note: The quotations have been freely translated. The meaning of the original Dutch version has been preserved.

Analysis of the data revealed that teacher educators valued the use of the TLP-instrument for several reasons, for example:

> "It provided me with insights about how I consider technology learning in the workplace. In what way I would like to do this on my own or together with other colleagues and … or I would like to do this in a spontaneous way or organised … and what learning objectives I have in mind. The questionnaire makes it possible to become aware of the way in which I prefer to learn. I am more aware of specific learning strategies based on what I need or will need." (semi-structured interview, teacher educator DP2).

In this example, the interviewee clearly found the TLP-instrument useful. The instrument provided the respondent with a language that made it possible to choose specific learning approaches that work best when acquiring new ICT knowledge and skills, currently and possibly in the future. This is in line with Ashburn and Floden's (2006: 36) research on meaningful learning, which indicates that specifying different "opportunities to learn about educational technologies" and "engaging in an extended process of learning" support teacher educators' technology learning for "enduring understanding". The interviewee explained that s/he did not interpret the scores on the TLP-instrument as definitive but considers this to be an opportunity to explore the ways s/he learns best:

> "Using the TLP-instrument enables me to consider my own technology learning … as a lifelong … learning journey … I like to see in what ways I can enhance my own technology learning process … which is certainly not a static process." (semi-structured interview, teacher educator DP2)

This example suggests that technology learning in this investigation should not be regarded as a stable or permanent trait but a preference based on current learning needs. Other teacher educators similarly approved of the use of the TLP-instrument as a tool to increase awareness about how they prefer to acquire technology knowledge and skills, which is evident in the following example:

> "Filling in the questionnaire has provided me with more knowledge concerning the way in which technology learning preferences can be categorised and what learning

preferences I have. I think that using two axes is an added value … it makes it possible to visualise my own technology learning preferences. Although the outcome was not surprising, the instrument helped me to become aware that acquiring ICT knowledge and skills is part of professionalisation. In other words, these are my learning preferences but they may be different … in other learning contexts." (semi-structured interview, teacher educator CP2)

The examples used in this section based on the analysis of the qualitative data from the semi-structured interviews showed that teacher educators found the TLP-instrument useful in increasing their awareness with regard to their preferred learning approaches that work best when acquiring ICT knowledge and skills. Additionally, example quotations made clear that the use of the TLP-instrument provided the educators with a tool that might foster conversation with others concerning their individual learning processes.

6.4.2 Data presentation from the semi-structured interviews about preferred technology learning activities.

During the preliminary research phase as discussed earlier in Chapter 5, a main strand that focuses on combined technology learning opportunities emerged from coding the data. As Research Questions 1 and 2 asked 'What learning activities do teacher educators prefer?' data from the semi-structured interviews were further examined during prototype and evaluation phase II. One prevalent feature in the analysis was that teacher educators believed technology learning activities should be needs-based and should meet their preferred learning mode(s), as shown in the following example:

> "For example, I would like to collect videos from the Internet. How can I do this? … I need a fixed learning module … in this way it helps me to improve my learning … and my lessons. In other words, this is what I need. Moreover, a person who assists me, … who is an expert, … and who is immediately available in case I need help." (semi-structured interview, teacher educator AP2)

In the example above, the interviewee states a strong preference for technology learning activities that suit his/her learning needs. It is clear that a modular approach with the assistance of an expert would help with the current learning issue of downloading Internet videos to use in

the classroom. This preference for expert assistance is supported by some researchers (Ashburn & Floden, 2006; Collins & Halverson, 2009) who emphasise that teacher educators need adequate support from an expert to "gain fluency in the technical aspects of the technology itself" (Asburn & Floden, 2006: 36). However, the data analysis suggests that teacher educators want more than merely a formal learning approach. Analysing the data for preferred learning activities revealed that a formal learning activity such as a short introduction to a workshop or course on the use of a specific software application is only valued when it is followed by an informal-individual technology learning activity:

> "I do think it is useful to have a general introduction … a formal introduction but I need to experiment on my own … to make it my own … based on my own learning need … which means that learning activities based on an informal … individual approach would be a suitable next step." (semi-structured interview, teacher educator CP2)

The preference for combined learning activities was mentioned several times during the semi-structured interviews. This preference corresponds to the results from the individual scores in the TLP-questionnaire as well as to the results from the preliminary research phase in which a main strand concerning teacher educators' preference for combined technology learning modes emerged. As discussed earlier, the scores revealed a preference for combined learning activities.

The findings from the semi-structured interviews corroborate Lohman's (2006, 2009) qualitative studies on the reliance of teachers on eight identified informal learning activities (Lohman and Woolf, 2001) and studies on informal learning in the workplace (Boud & Middleton, 2003; Hager & Halliday, 2007). The findings in this investigation extend the understanding of this topic by revealing that teacher educators prefer more than a single learning mode such as informal learning. Collegial availability and support in informal learning contexts are also valued, indicating that combined technology learning modes such as informal-collective learning are considered more useful than single learning modes.

Insights from prototype and evaluation phase II were then used to examine technology learning in interdisciplinary teams across the teacher education institution during Prototype Phase III. Reflective reports and semi-structured group interviews were used to collect data

about preferred learning modes, learning activities, factors and strategies that promote engagement in technology learning.

6.5 Data presentation Prototype Phase III

As discussed earlier in §6.4.1, a second main strand emerged from coding the data that focuses on the utility of the TLP-instrument. To further examine how teacher educators in three interdisciplinary teams, Alpha, Beta and Gamma, valued the TLP-instrument, analysis of the data from the reflective reports and semi-structured group interviews was conducted. Teacher educators were provided with a TLP-questionnaire which had been refined based on the data collected during Phase II. Only two questions which created problems due to lack of clarity were refined. The instructions about the plotting of data from the TLP-questionnaire in the graph were slightly changed for clarity. The definitions of the four single learning modes on the first page of the TLP-instrument posed a problem for five participants who were unclear on the interpretation of the definitions. A deeper analysis of the literature on the four learning modes was conducted to clarify the definitions.

In the following sections, a summary of each semi-structured group interview will be given, followed by a discussion of the teacher educators' technology learning preferences. Next, an overview and discussion of teacher educators' responses about the use of the TLP-instrument will be provided. Finally, an overview of factors and strategies that influence teacher educators' engagement in technology learning processes will be discussed.

6.5.1 Data presentation of the interdisciplinary teams

The first step in the analysis consisted of combining and summarising the results from the three interdisciplinary teams on the two data collection instruments: reflective reports and semi-structured group interviews. Next, patterns concerning teacher educators' learning preferences scores and statements from the short reflective reports and semi-structured group interviews were examined.

Team Alpha (n = 4)

An examination of the individual technology learning preferences revealed that all four teacher educators in Team Alpha had a strong preference for individual-informal technology learning. During the semi-structured group interview, teacher educators indicated that there was a strong link between their learning preferences and aspects of individuality, freedom of choice, and intrinsic motivation. All four interviewees explained that the TLP-instrument helped them to make their technology learning preferences more explicit. The four teacher educators indicated that the process of completing the questionnaire yielded a better understanding of their own technology learning, and that it could contribute to choosing more adequate professionalisation activities and trajectories. One interviewee stated that adequate professionalisation is not only based on formal professionalisation programmes, which focus too much on certification. This view was discussed among the four group members during the group interview. All four teacher educators considered the issue of certification as a serious problem within the institution and suggested that the management should place a higher value on informal technology learning activities. An example of a factor that the interviewees believed contributed to their technology professionalisation included experimenting with new technologies based on their individual learning issues. The teacher educators in Team Alpha indicated a need for more activities that facilitated experimentation in informal situations. According to the interviewees, factors that impede the process of technology professionalisation are lack of time and poor ICT infrastructure. Additionally, the four interviewees emphasised the discrepancy between organisational professionalisation goals and individual learning needs.

Team Beta (n = 5)

The five teacher educators in Team Beta indicated that their individual technology learning preferences profile based on the outcomes of the questionnaire did not reveal something completely new to them. Nevertheless, the discussion among the five interviewees during the semi-structured group interview showed that the TLP-instrument contributed to a better understanding of their individual technology learning preferences. The five teacher educators indicated that the use of the TLP-instrument enabled them to consider their technology learning in the workplace in a more nuanced way. Analysing the reflective reports as part of the semi-

structured interviews revealed that all five interviewees valued the TLP-instrument for the insight it provided on combined learning preferences. Four teacher educators stated that the TLP-instrument could be useful in organising learning activities that meet their learning preferences and evolving learning needs. Based on the outcomes of the questionnaire, all five teacher educators indicated a preference for either informal-individual learning activities or informal-collective learning activities. Experimenting in small groups and participating in individually based activities were highly valued. However, almost all interviewees identified a tension between their preferred technology learning preferences (i.e., informal-collective learning) and the way in which the organisation facilitates professionalisation programmes which are mostly based on a formal-collective approach and not adjusted to the learners' needs. All five teacher educators suggested that managerial boards should accept and facilitate informal technology learning initiatives and activities.

Team Gamma (n = 3)

Based on the individual TLP-scores and data from the semi-structured group interview, respondents from Team Gamma indicated a strong preference for informal-individual technology learning activities. During the group interview, two participants stated that formal learning activities are not useful to them, which corresponds to their individual scores based on the scores from the TLP-questionnaire completed before the semi-structured group interview. One participant indicated that formal learning activities only work when s/he needs a general introduction to a new ICT application. All three teacher educators approved of the use of the TLP-instrument because it helped them to enhance the transparency of their technology learning professionalisation. In addition, the use of the TLP-instrument provided them with a language for discussing their technology learning preferences and related activities with their managerial boards. A factor which promotes teacher educators' engagement in technology learning activities is managements' acceptance of informal learning activities as part of their professional development process. The three teacher educators in Team Gamma indicated that traditional, formal professionalisation opportunities such as workshops and courses were at present considered to be the only accepted means of professionalization by management. They reported that increasing the amount of technology professionalisation would foster participation

in technology learning activities. For the TLP-questionnaire, the mean scores and standard deviations for the four technology learning preferences were computed for the three interdisciplinary teams, as shown in Table 6.5.

Table 6.5 *The composition of teams (N = 12)*

Technology learning preferences	Team Alpha (n = 4)	Team Beta (n = 5)	Team Gamma (n = 3)
Formal technology learning	2.0 (1.4)	1.0 (1.3)	2.3 (4.0)
Informal technology learning	11.5 (7.4)	11.0 (4.8)	14.0 (3.6)
Collective technology learning	6.3 (4.6)	6.0 (4.5)	7.7 (3.1)
Individual technology learning	13.8 (3.2)	11.2 (3.6)	16.0 (5.3)

Data is presented as sample mean M and standard deviation (SD)

As Table 6.5 shows, the 12 teacher educators generally prefer informal and individual technology learning activities: In all three interdisciplinary teams, the majority of the respondents did not prefer formal learning activities (mean 1.58 and SD 2.15). This also applies to collective learning activities, although teacher educators valued collective learning activities more than formal learning activities.

Following the analysis of the individual TLP-scores based on the data from the TLP-questionnaire, the results for the four technology learning preferences were next compared to the specific learning preferences reported in the short reflective reports and the semi-structured group interviews. Comparison of the TLP-scores with the reported statements showed that the four technology learning preferences are clearly reflected in the teacher educators' reflective reports. An example is:

> "I do prefer to learn on my own, and if needed I like to get assistance from an expert colleague. It is important to me that I am able to learn whenever and wherever it suits me. I like to take the initiative in the learning process and I like to decide on my own what I need to learn … what is necessary to learn. I prefer to have many different learning possibilities … activities … which I can use to practice or to experiment with. However, I do not like to work in groups … together with others." (reflective report, respondent KMP3)

In this example, the teacher educator's high TLP-score on individual-informal technology learning is revealed in the reflective report which clearly favours individual and informal learning activities. This respondent described technology learning as a process which should occur whenever and wherever it suits him/her. Additionally, it is important that s/he can be in control of his/her own learning process, that is, technology learning seems to be based on personal urgencies and objectives. Another teacher educator described his/her technology learning preferences as follows:

> "If I see an ICT application, which I have not seen before and which I like to use in my own teaching context, … I prefer to explore the potential pedagogical possibilities of it. I prefer to explore the application on my own and I like to do this in my own time. Working together in groups is only useful to me when the group members have the same learning issues … needs. It is important to me that the group members have the same experiences and prior knowledge." (reflective report, respondent LGP3)

This respondent's TLP-score on individual-informal technology learning and low preference for collective learning is evident in both the content of the reflective report's excerpt and in the way the report was written, with a strong, decisive tone.

6.5.2 Data presentation about the use of the TLP-instrument across the three interdisciplinary teams.

To examine in more depth the second main strand to what extent to which the TLP-instrument was valued across the three interdisciplinary teams, teacher educators were asked to respond to the following two questions: 'In what way was the TLP-instrument helpful to you?' and 'In what way does the TLP-instrument help you with your own technology professionalisation process?'

The analysis of the data from the semi-structured group interviews revealed that the TLP-scores were not a surprise for most teacher educators. The data from the reflective reports and the semi-structured group interviews in many ways reflected the outcome of Prototype Phase II. However, the analysis of the data of the three semi-structured group interviews and the data from the individual reflective reports during Phase III revealed a more detailed picture of how useful the TLP-instrument was for respondents:

> "It gave me more insight into what I do prefer … It made me more aware that the choices and the learning preferences depend on the contexts and that it depends on the sort of learning objectives I have. Although I know that I prefer informal technology learning activities, the questions, … of the instrument enabled me to realise that the choices are based on my own predefined learning objectives." (reflective report, respondent JBP3)

> "It makes me aware of the fact that whenever there is a need … to professionalise … the way in which the learning is done matters. I can now indicate … by making use of the instrument what sort of learning I do prefer and what learning activities are suitable in a particular teaching context." (reflective report, respondent KMP3)

Both teacher educators quoted above indicated that the instrument increased their awareness of how they prefer to learn. Additionally, they indicated that having a better understanding of one's own learning process makes it easier to choose technology learning activities that correspond to their preferred way of learning and to address specific issues in their teaching practice.

During the three semi-structured group interviews, the teacher educators explained how the TLP-instrument enabled them to clarify how they prefer to learn ICT knowledge and skills. One example is:

> "Filling in the questionnaire … instrument forces me to actively think about my own technology learning preferences. Do I prefer individual learning or do I prefer to collaborate in a group or community? It made me aware that it depends on the situation." (semi-structured group interview, respondent IWP3)

One teacher educator stated that the instrument increased his/her capacity for metacognitive control of his/her technology learning process, which enables him/her to monitor, reflect and adjust his/her learning approaches in different learning contexts:

> "The instrument has helped me for it urges me to think in a critical way about my learning. How I professionalised … in the past … what did or did not work … the tops

> and flops. Quite often, technology learning programmes take place in a formal way … but I noticed that this does not work for me. In general, it does not meet my learning needs … and working contexts. I now know what works for me and what activities I do prefer." (semi-structured group interview, respondent FCP3)

The TLP-instrument also provided a language for discussing technology learning preferences and technology professionalisation. Examples from the data suggest that the TLP-instrument can foster conversation among teacher educators and managerial boards about how to create a more effective technology professionalisation process. Some examples are:

> "The instrument is an eye-opener to me. It enables me to explain to others in my own words that formal learning does not work for me. I can make it clear to my team leader that there are far better opportunities … suitable professionalisation activities … rather than the standard … traditional workshops and courses." (reflective report, respondent WBP3)

> "With this instrument I can make it clear and explain to my senior managers that a general, formal professionalisation programme does not work for me. The focus is too much on a recognised credential such as a certificate or diploma, whereas professionalisation should focus on my learning needs." (semi-structured group interview, respondent LGP3)

The analysis of the data from the teacher educators' reflective reports and the semi-structured interviews revealed that the TLP-instrument was considered useful for mapping teacher educators' individual technology learning preferences. The results correspond to the results of the prototype and evaluation phase II in which the second main strand revealed four categories about how the TLP-instrument supported teacher educators' technology learning. The TLP-instrument made it possible to describe their technology learning preferences based on their individual learning needs in response to the demands of their educational context. The

following section covers the analysis of data from the reflective reports and semi-structured interviews concerning teacher educators' preferred technology learning activities.

6.5.3 Teacher educators' preferred technology learning activities

As discussed in Chapter 2, previous research on the professionalisation of teachers and teacher educators has shown that teachers learn from deliberate practices (Dunn & Shriver, 1999), collaboration with colleagues (McCotter, 2001; Little, 2002) and informal learning (Lohman, 2006; Hoekstra et al., 2007). In studies about student learning, considerable attention has been paid to precise descriptions of how they learn and what learning activities they prefer based on their learning styles (Vermetten et al., 1999). Several studies indicate that learning activities are chosen based on different learning needs (Vermunt, 1996, 1998; Ally, 2004; Vermunt & Vermetten, 2004; Harris et al., 2009). These findings are important in light of this research because teacher educators may choose different technology learning activities based on their varying learning needs.

Teacher educators were asked to describe in their reflective reports what technology learning activities they prefer, in order to address the second part of Research Questions 1 and 2, 'What kind of technology learning activities in the workplace are preferred by teacher educators? The analysis of the data from the reflective reports and the discussion during the three semi-structured group interviews resulted in the various technology learning activities shown in Table 6.6.

Table 6.6 *Illustrative responses from teacher educators across the three interdisciplinary teams*

Preferred learning activities	Sample responses
Formal learning	- Meaningful study days with all teacher educators - Workshops led by an expert or several experts
Informal learning	- Talking with others - Observing students or colleagues using technology
Collective learning	- Working in small groups sharing ideas and experiences - Participating in online communities or fora
Individual learning	- Exploring the possibilities of an ICT application on my own - Watching useful clips on YouTube or other media

All reported technology learning activities found in the data from the reflective reports and the semi-structured group interviews could be placed in the learning preferences categories as shown in Figure 5.1 that emerged as a main strand from coding the data during the preliminary research phase. Although the data from the teacher educators' TLP-scores and the reflective reports revealed that they have a strong preference for informal learning, the data analysis yielded no clear examples of specific informal technology learning activities. During the semi-structured interviews, teacher educators indicated that identifying specific informal learning activities was not simple because they arise from specific learning contexts. One teacher educator described his/her informal learning activities as activities which "go beyond the classroom" (teacher educator AGP3). However, the respondent added that such learning is in most cases not accepted by managerial or human resources boards because this learning is mostly not delivered by trained experts in a systematic intentional way and does not meet the institutional professionalisation goals.

As for individual technology learning activities, the majority of teacher educators' reflective reports stated that individual learning activities are based on their personal learning needs. Working at "one's own pace and whenever it is most convenient" such as "watching a knowledge clip on YouTube" (teacher educator TFP3) and "being more in control when choosing and selecting learning materials" (teacher educator JBP3) are essential aspects of individual learning activities. The following section discusses inhibiting and contributing factors that influence teacher educators' engagement in specific technology learning activities.

6.5.4 Factors and strategies that influence engaging in technology professionalisation

Previous studies have helped to develop a greater understanding of factors influencing learning activities in the workplace (Firestone & Pennell, 1993; Woerkom et al., 2001; Kwakman, 2003; Goktas et al., 2009). Other studies have examined factors that inhibit or contribute to teacher educators' engagement in technology learning activities (Mumtaz, 2000; Schoepp, 2005; Drent & Meelissen, 2008; Tondeur et al., 2008; Bingimlas, 2009). To address Research Question 3 and to gain more insight into these factors and preferred technology learning methods, data from the reflective reports and semi-structured group interviews was analysed. An overview of

inhibiting and contributing factors which emerged during the analysis process as a third main strand from coding the data is presented in Table 6.7.

Table 6.7 *Overview of factors and strategies as reported by teacher educators*

Inhibiting and contributing factors and strategies	**Sample statements**
Inhibiting factors	- Lack of time to professionalise - Too much focus on certification rather than professionalisation - Too much focus on formal learning activities - No sustained professionalisation programmes
Contributing factors	- Possibilities to experiment based on personal technology learning needs - Working together in small groups - Choosing one's own learning trajectories - Acceptance of informal learning possibilities by management

Examination of the data revealed that several respondents indicated that one of the inhibiting factors is the lack of time to engage in a variety of technology learning activities. One additional inhibitor related to lack of time was lack of funds. During the semi-structured group interviews, teacher educators indicated that both factors inhibit them in choosing adequate professionalisation trajectories based on their personal technology learning needs. Another inhibitor frequently found in the data was the focus of managerial boards and human resources departments on formal trajectories, which in most cases do not correspond with the learners' preferred learning activities. One teacher educator described this as follows:

> "The focus within the institution is not on professionalisation but on certification. It seems that there is no personal need to professionalise … but more the need from management to make sure that all teacher educators get certified. I am of the opinion that there should be an intrinsic motivation … a personal need to professionalise based on individual learning issues. It does not help when management forces someone to join or participate in a standard … traditional … formal activity." (semi-structured group interview, respondent LGP3)

During the semi-structured group discussions, a few teacher educators asserted that specific technology skills require a formal, traditional approach followed by an informal-individual or informal-collective activity. This finding corroborates the findings from the preliminary research phase about teacher educators preferring combined technology learning methods which should start with a formal learning approach.

Contributing factors which encourage teacher educators to engage in technology learning activities were personal initiative and possibilities to experiment based on personal learning needs. Several teacher educators added to these factors the possibility to reflect on their own experimentation when they have a need to learn in the workplace. As one teacher educator stated, “When a moment of learning occurs, I like to get an opportunity … time to reflect on it and think about it” (teacher educator JBP3). Respondents expressed the desire to learn from their own experiences in order to become better technology users in educational contexts.

In Chapter 2, effective professional development trajectories were discussed that are preferred to support teacher educators’ technology learning. Much of the literature describes general principles for professional development but does not address the preferred individual technology learning needs of the teacher educators (Cranton, 1996; Schrum, 1999; Billett, 2001; Loucks et al., 2009). To gain a better understanding of this issue, the qualitative data was analysed for strategies that the participants considered supportive of their technology learning.

The data analysis reveals the results for the professionalisation strategies that participants considered to contribute to their learning. Participants indicated that strategies which promote professional development should have a strong focus on acquiring ICT knowledge and skills that meet their learning needs:

> “What I do miss in the current approach … of the teacher education institution is the lack of a strategy which focuses on what I call … the know-how and skills which I need in my own … teaching. I do experience the professionalisation processes as not related to my teaching context. They are therefore not useful in my situation.” (semi-structured group interview, respondent JBP3)

This respondent indicated that the present professionalisation strategies do not focus on the learning issues of the teacher educator. Another teacher educator mentioned that too often professionalisation strategies within the institution focus on acquiring general knowledge and skills that are not applicable to his/her teaching practice:

> "What I do think is a waste of time is that the institution often provides courses or workshops which are too general… I mean, I cannot do anything with them. Most of them are absolutely not useful! They even use technology that we do not have … it is not available to us. So why are they doing this?" (semi-structured group interview, respondent LGP3)

One common criticism found during the analysis process was that the technology professional development programmes were too short and that the institution provided only limited follow-up and support to the teacher educators:

> "I do think that in general a workshop or course which lasts only a few hours is too short. A couple of months ago we had a workshop which lasted only 3 hours, … and most of us wanted to know more about it but liked to do this in our own time … and when needed with support from an expert … but that was not the case." (semi-structured group interview, respondent PGP3)

This example shows that the teacher educator considered professionalisation programmes to be too short and to lack the necessary support from an expert. In addition, this remark shows that professional development should be adjusted according to the teacher educators' preferred technology learning methods. This is in line with studies about effective professional development programmes (McLaughlin & Talbert, 2006; Punuel et al., 2007). However, it should be noted that teacher educators' technology learning preferences in relation to professionalisation strategies is not included in most of the studies, as discussed in Chapter 2, which limits the understanding of teacher educators' technology learning in the workplace.

Findings and implications

Teacher educators indicated that a greater amount of unencumbered time must be available for them to engage in individual-informal technology learning activities. Being in control of one's own learning is a critical factor in teacher educators' willingness to actively engage in technology learning activities. The ability to experiment with technology and adequate support are important contributors to the learning process and are related to the problem of a lack of time. Experimentation takes time and should include activities that engage teacher educators throughout their workday.

Consequently, the teacher educators in this research indicated that their professionalisation programmes need to be aligned with their individual technology development preferences, based on what they consider as inhibitors and contributors to engaging in technology learning activities. Strategically designed technology learning activities would address the lack of time while increasing ownership. The teacher education institution should support experimentation with technologies and provide the time and support necessary to fulfil the teacher educators' learning preferences and needs. Additionally, findings in this research suggest that individual technology professionalisation opportunities should focus more on an ongoing learning process that centres on the learning issues that are directly related to the teacher educators' teaching practices.

6.6 Summary and conclusion.

The main strand that emerged from coding the data during the preliminary research phase was further explored during the prototype and evaluation phases. The aim of the prototyping discussed in Chapter 6 was to design, develop and refine the TLP-instrument to support teacher educators' technology learning in the workplace.

During the coding process In Chapter 5, teacher educators' technology learning preferences were explored based on the data obtained in semi-structured interviews and a questionnaire. The aim of the prototyping discussed in Chapter 6 was to design, develop and evaluate a technology preferences instrument for teacher educators. The TLP-instrument was constructed as a tool for mapping technology learning preferences in the workplace. The instrument was intended to serve as a means to increase teacher educators' understanding of

their own technology learning process based on their individual approaches to technology learning. Increasing awareness of how they prefer to learn technology provides educators with a language for discussing specific technology learning preferences and professional development activities.

During Prototype Phases II and III, participants reported an increased self-awareness of their technology learning preferences and related activities. The data from the semi-structured interviews during Phase II and the reflective reports and semi-structured group interviews during Phase III revealed that the majority of teacher educators who participated in the research preferred the combined learning mode of individual-informal technology learning. The teacher educators indicated that traditional technology professional development programmes are not their preferred means of professionalisation. In addition, they indicated that formal technology professional development programmes are in most cases too short and lack a connection with their teaching practice. Several teacher educators emphasised that they have limited influence or control of their own technology learning process and identified a need to control their own learning process and to choose needs-based activities. In the following chapter, an overview and additional discussion of the results of the preliminary research phase and the three prototyping phases will be presented. Based on the findings, the limitations of the research and suggestions for further investigation will also be discussed.

Chapter 7:

General discussion, conclusions and recommendations

7.1 Introduction

One of the aims of this research is to provide a deeper understanding of which technology learning preferences, activities and factors teacher educators perceived to be beneficial to their technology learning in the workplace. The other aim of this research is to design and develop a TLP-instrument which supports teacher educators' individual professionalisation trajectories.

The purpose of this chapter is to provide a discussion of the findings presented in Chapters 5 and 6. The chapter is organised into the following sections: a) a discussion of the main findings with regard to the research questions, b) the contribution to a conceptual understanding and teacher educators' practice, c) research limitations, and d) implications and suggestions for future research and practice about teacher educators' technology learning in the workplace.

7.2 Main findings with regard to the research questions

Research Question 1: What kinds of formal and informal learning methods and activities do teacher educators prefer as part of their technology professionalisation?

The analysis of the teacher educators' mean scores during the preliminary research phase showed that formal or informal learning methods alone are not strongly valued, although combined learning methods were highly valued. Evidence for these findings was to be found in responses to the open question in the web-based questionnaire and statements from the semi-structured interviews. Although the findings are in line with those of several researchers (Darling-Hammond et al., 2005; Timperley, 2009; Desimone, 2011) it should be noted that in studies on workplace learning, teacher educators' learning is often described in terms of single learning preferences and activities (Eurostat, 2006; Lohman, 2006, 2009). This is in contrast to the findings in this research, in which a main strand emerged from coding the data that revealed

that teacher educators juxtaposed several preferred combined technology learning methods, such as individual-informal learning and collective-informal learning. The term *combined modes of learning* was used to indicate that respondents preferred more than a single learning method when acquiring new technology knowledge and skills. The four combined learning modes that emerged during the preliminary research phase served as an outline of teacher educators' preferred learning methods.

Examination of the qualitative data from the semi-structured interviews during the preliminary research phase provided more detail on preferences for technology learning. Encouraging participants to expand on their responses during the interviews opened up more discussion and provided more profound insights into their learning preferences and related activities. Findings in the semi-structured group interviews during phase II of the prototype development confirmed the results of the preliminary research phase. However, in the prototype and evaluation phases, respondents indicated that collective-informal learning was more valued than they did in the preliminary research phase. A possible explanation is that the type of questions in the preliminary research phase did not focus on combined learning modes. This understanding emerged gradually during the research process based on the analysis of the qualitative data collected during the prototype phases.

The learning activities that teacher educators preferred can be assumed to be part of their preferred learning methods, which has important implications for their professional development trajectories. Their statements clearly indicated that informal learning offers a way to participate in educational pursuits while engaging with learning solutions that would not be open to them through more formal professional development programmes. Several respondents indicated during the semi-structured interviews that the traditional workshops focus too often on an ICT tool or ICT approach which do not meet their personal technology learning needs. The opportunities to combine different informal learning methods based on changes in teacher educators' learning needs suggest that it is worthwhile in professional development programmes to pay attention to these changing learning needs. Professionalisation programmes that are tailored to the particular concerns and needs of the teacher educator might contribute to sharing these acquired technology knowledge and skills with others. Additionally, the analysis of the data in this research indicated that enhancing individual learner

control with regard to technology professional development processes might contribute to meaningful learning.

Research Question 2: What kinds of individual and collective learning methods and activities do teacher educators prefer as part of their technology professionalisation?

The analysis of data during the preliminary research phase revealed that teacher educators valued collective ways of learning. The interviewees valued the combined mode of collective-informal learning. The interaction with colleagues and group work facilitates the sharing and distributing of technology knowledge and expertise. Additionally, participants valued informal learning aspects, such as authentic learning situations, self-paced and open-ended time allocation and the absence of pre-set learning objectives. A short, formal introduction of a group activity was still regarded as useful. Interviewees valued an expert's help and support as needed during group activities, which suggests that learners might prefer to be in control of their own learning.

Teacher educators' responses from the reflective reports and semi-structured (group) interviews were qualitatively analysed, as discussed in Chapters 3 and 4, by searching for patterns which confirmed the individual TLP-scores. The analysis of the data from the reflective reports and semi-structured interviews during the prototyping phases produced a more nuanced picture. Respondents indicated that they valued learning with other colleagues, and collaborating with colleagues often consisted of exchanging ideas, sharing thoughts or reflecting on one's use of technology in the classroom. Asking colleagues for feedback or assistance was reported as useful and as constituting meaningful learning moments. However, the reflective reports indicated that collaborating in groups or communities was only useful when it contributed to the learner's current learning needs. Although studies on learning in groups (Parker & Chao, 2007; Dillenbourg et al., 2009; Barkley et al., 2014) focus on the benefits of collaborating with others, such as the social construction of knowledge, little attention has been paid to the individual learning needs in collective learning activities. In this research, teacher educators cited a lack of a common learning goal or effort in collective technology learning activities. This is a point of discussion because the question could be how effective are collective learning activities in learning new ICT knowledge and skills. As discussed in Chapter

6, the qualitative data showed that the participants' technology learning was mainly driven by their own learning needs. This suggests that interactivity in collective learning can be very engaging and useful provided that the participants share similar issues and concerns.

Research Question 3: What factors and strategies promote teacher educators' technology learning in the workplace?

Several studies (Bradly & Russell, 1997; Ertmer, 1999; Bullock, 2004; Schoepp, 2005; Goktas & Yildirim, 2009) have identified factors and strategies that affect technology integration in teacher education programmes. As discussed in Chapter 2, more research needs to be done to explore the main factors and activities that promote the uptake of technology use in relation to teacher educators' preferred technology learning methods in the workplace. In this research a close examination of the data revealed a second main strand which emerged from the data and which indicated inhibiting and contributing factors concerning teacher educators' technology learning in the workplace.

Teacher educators' responses from the semi-structured interviews and reflective reports during the preliminary and prototyping research phases indicated that expecting them to train themselves on their own time slows down the ICT learning process. Several respondents identified the lack of time as a factor that impedes the learning of new technology knowledge and skills. To overcome this problem, they would need more time to devote solely to different learning activities. Providing more time enables learners to reflect on their own learning processes which is in line with Schön (1983), Raelin (2001), and Moon (2013) who state that systematic reflection on practice is critical for many professionals who are engaged in complex learning activities. Participants' in this research suggested that professional development strategies should consist of opportunities and sufficient time which enable them to look back on their learning processes which encourages to think about what they might improve in the future.

Teacher educators identified a lack of adequate professional development activities as another inhibitor, and their responses indicated that current professional development activities are too focussed on skills training that is based on a *just-in-case* concept. Although several studies (Lee, 1997; Cox et al., 1999; Snoeyink & Ertmer, 2002; Collins & Halverson, 2009) emphasise the inadequateness of skills training, less attention is paid to the individual learning

preferences and related strategies that contribute to adequate professionalisation programmes. In the analysis of the qualitative data collected from the semi-structured interviews, teacher educators stressed the need to align learning activities with their preferred learning methods because as one teacher educator mentioned, “one size does not fit all”.

Another inhibiting factor which the respondents indicated was that management focusses too much on certification programmes rather than professional development strategies that are tailored to individual learning preferences. The educators in this research were frustrated by the expectation that most of the management’s chosen professionalisation activities showed no congruence with the learners’ teaching practice, and receiving a certificate or diploma did not motivate them. This suggests that certification does not mean that teacher educators are better at using technology in their teaching. As a solution, respondents suggested that any first stage of a professionalisation strategy should focus on what the learners need to learn and in which ways they prefer to learn. The initial stage should be followed by a stage that is designed according to the educators’ experiences and skills in using technology in the classroom. In this way, differing amounts of skills training could be delivered according to the individual learners’ needs and existing skillsets.

Research Question 4: How can a continuing technology learning preferences instrument be designed for technology professionalisation based on teacher educators’ preferences regarding the level of formality and the degree of collectivity in their learning process?

In the same way that the design-based research approach relied on iterative, cyclical stages of data collection and analysis, the design, evaluation and refinement of the TLP-instrument evolved gradually. The aim of developing the prototype instrument was not the instrument itself, but more of an exploration of the ways in which it could support teacher educators’ technology learning. Examining the data in depth revealed a main strand that indicated to what extent the TLP-instrument was valued by the respondents.

Over the past few decades, research in the area of learning styles and preferences has increasingly focussed on what Cassidy (2004: 421) calls the “state-or-trait debate”. Several researchers (Loo, 1997; Cassidy, 2004; Coffield et al., 2004; Kolb & Kolb, 2005; Berings et al., 2007) indicate that research does not provide a consensus on whether learning styles can be

regarded as stable in various learning contexts—as traits—or as changing with each learning situation—as states (Cassidy, 2004; Berings et al., 2007). The debate focuses on the issue of stability in learning styles and whether learning styles change across various learning contexts. Investigating the issue of stability, Loo (1997) recommends caution in drawing a firm conclusion with regard to learning style stability in different learning contexts (as cited in Cassidy, 2004: 421). The findings in this research suggest that teacher educators adapt their ways of learning and activities in various learning situations. Data from the reflective reports and semi-structured interviews showed that respondents' preferred learning methods to be responsive to their individual learning needs in changing contexts. This might suggest that technology learning in various learning contexts is neither context specific nor cross context consistent. In this research, the term learning preferences is therefore more appropriate because the findings suggest that technology learning in the workplace is a dynamic and interactional process between the teacher educator as a learner and his or her practice.

The analysis of the qualitative data revealed further that teacher educators valued the use of the TLP-instrument as a means to map their preferred ways of technology learning due to different needs in various learning contexts. The respondents indicated that the TLP-instrument served as a tool to increase their own process of acquiring technology knowledge and skills. During the analysis process, four categories emerged that described the way in which the TLP-instrument supported teacher educators' technology learning: an increased awareness, understanding, insight, and use of vocabulary to discuss their preferred ways of learning due to different needs in different contexts. As the first three categories overlap in their focus on understanding the preferred learning processes, the fourth category provides a language for discussing individual ways of learning and related activities with others. The teacher educators indicated that the instrument could therefore be regarded as a means to foster conversation across the institution among different stakeholders, for example with other teacher educators, professional development facilitators, and management boards.

The TLP-instrument provides a personal profile of the preferred ways of technology learning and related activities that teacher educators prefer to use in the workplace. The TLP-instrument can be used by teacher educators, management boards, and professional

development facilitators to raise awareness with regard to preferred CTPD programs in the workplace.

7.3 Contribution to a conceptual understanding and teacher educators' practice

As several researchers have noted, (Cobb et al., 2003; Linn et al., 2004; Siggelkow, 2007), individual studies do not always yield rich, detailed understanding, although the conceptual understanding they provide can help in the construction of new theories. In this research, the term 'conceptual understanding' refers to insights about teacher educators' technology learning, on different levels, which contributes to describing, explaining and predicting aspects of technology workplace learning.

As discussed in Chapter 3, development of the TLP-instrument was based on several iterative cyclical stages and on a collaborative task between the teacher educators and the researcher. This process can be seen to have provided coherence to the investigation and to have enriched the data collected in several research phases. The insights about teacher educators' technology learning which emerged during the different prototype phases could be used to evaluate, refine and improve the TLP-instrument and contributed to a better understanding of technology learning in the workplace. Because the results and insights are situated in a real educational context, they might be effective for improving teacher educators' technology learning not only in this research context but maybe also in other contexts. However, being intimately involved as a researcher and teacher educator in the conceptualisation, design, development and refinement processes of the TLP-instrument posed some challenges for making credible and trustworthy assertions, especially about the range of educational contexts. The use of mixed methods as suggested by Onwuegbuzie and Leech (2007) and Creswell and Plano-Clark (2011) minimised the researcher's bias.

Design-based research was an effective research approach on the whole in the creation and testing of the separate prototypes of the TLP-instrument. The refinements based on the teacher educators' feedback from their reflective reports and the semi-structured interviews added to the continuous evolution of the TLP-instrument. In line with Barab & Squire (2004) and Anderson & Shattuck (2012), it should be noted that the evolution of the prototype's design and development was a challenge because it was difficult to assess when the creation, testing and

evaluation of the instrument would be completed. The goal of this research was to investigate and meet the immediate practical needs of teacher educators' technology learning in the workplace, but there was also a complementary goal of contributing to a conceptual understanding.

The discussion below presents three different levels of conceptual understanding that are based on the findings in this research. However, before proceeding, it is necessary to discuss these three levels of conceptual understanding briefly.

Local conceptual understanding

This research contributes to a conceptual understanding that is closely tied to the specifics of teacher educators' technology professionalization. Local understanding in this research refers to the insights that emerged during the investigation of certain aspects of teacher educators' preferred technology ways of learning and preferred learning activities within a local context.

Middle range conceptual understanding

In this research, contributions to a middle-range conceptual understanding were developed during the separate iterations of investigation which were "studied in several settings" (Mckenney & Reeves, 2012: 36). Especially, as the design and development of the TLP-instrument began to mature during the separate research phases, the research strived to develop conceptual understanding which goes beyond the local context and tries to investigate whether the insights from the local context are applicable to other teacher educators' contexts.

High-level conceptual understanding

High-level understanding combines and synthesizes insights with regard to phenomena of technology learning in the workplace that emerged during the research in different settings. The conceptual understanding based on the research findings can be used for predictive and prescriptive purposes in different contexts which focus on teacher educators' technology professionalization.

Table 7.1 *Overview of various kinds of conceptual understanding concerning teacher educators' technology professionalisation in the workplace*

	Level		
Purpose	**Local conceptual understanding** Applicable to a small context and applicable to one teacher educator's individual technology professionalisation	**Middle-range conceptual understanding** Builds on local understanding and applies to small groups or teams of teacher educators	**High-level conceptual understanding** Builds on middle-range understanding and applies to teacher educators' cross-institutional contexts
Describe	Teacher educator prefers specific technology learning methods	Certain degrees of technology learning are found in small groups or communities of teacher educators	Different learning needs in different learning contexts has a positive effect on meaningful learning
Explain	Teacher educator prefers certain technology learning methods based on contextual learning needs and wishes	Teacher educators value working in small groups if it meets their individual technology learning needs and wishes	Conducting inquiries and experimenting with a variety of activities foster curricular ownership
Predict	Teacher educators who are able to choose their own learning activities based on their technology learning preferences and learning needs will be more likely to use and integrate technology in their teaching practice	Collective learning in a community should meet the personal technology learning needs of the teacher educator to make collective learning a successful process	If technology professionalisation programmes are well-designed, this will foster curricular technology integration that meets students' learning needs and wishes
Prescribe	Providing teacher educator with different technology learning methods and activities based on his/her learning needs and wishes will yield more ownership	Providing teacher educators with different choices to learn in different groups that are needs-based	Providing teacher educators with tailored professionalisation options. Encouraging professionalisation across the institution

This table has been adapted and devised from McKenney, M., & Reeves, T. (2012). *Conducting Educational Design Research.* London: Routledge p. 38.

Local conceptual understanding

As design-based research was conducted in this study, in a context in which various actors participate in workplace learning, much of this investigation contributes to a conceptual understanding of teacher educators' technology professionalisation. On an individual level, teacher educators indicated that the TLP-instrument helped them to map their preferred technology learning methods. Gaining more awareness, understanding, and insights into preferred learning methods enabled respondents to think about appropriate individual professional development trajectories. Additionally, the TLP-instrument was seen as having the potential to foster conversation with other colleagues, management, and professional development providers.

An explanation for these findings is found in the responses from the reflective reports and semi-structured interviews about the use of the TLP-instrument discussed in Chapters 5 and 6. An important finding in this research is that an active role in the educator's personal learning process encourages commitment and ownership. Being actively involved in the design of one's own technology learning process based on preferred learning methods to meet different contextual learning needs may have a positive influence on the uptake of emerging technologies in the classroom. The analysis of data in this study showed that teacher educators who are more reflective and aware of their own technology learning process are more likely to acquire meaningful technology knowledge and skills, which suggests that this could contribute to the implementation of technology within the curriculum.

On an individual level, customisation based on just-in-time learning as the counter to the traditional professional development programmes which provide knowledge and skills that one might need to know, are highly valued. Just-in-time learning helps individual teacher educators connect their learned knowledge to classroom practice. Additionally, support that is tailored to teacher educators' particular concerns and needs contributes to a meaningful learning process. The implications of this more meaningful learning are far-reaching. As teacher educators are more concerned with the integration of technology in their teaching, it has the potential to transform their understanding into forms which may contribute to their students' learning process. In fact, teacher educators who want their student teachers to engage in meaningful

learning must provide different learning activities that actively engage students in analysing, synthesising and constructing new knowledge and skills.

Middle-range conceptual understanding

Middle-range understanding is characterised by a more limited scope and less abstraction than broader or high-level theories (Pawson, 2008; Hedström & Udehn, 2009; Pinder & Moore, 2012). In this research, middle-range understanding addresses teacher educators' technology learning in terms of how it builds on local understanding. The prototypes of the TLP-instrument in this research were further refined and evaluated during the prototyping and evaluation phases by collaborating with teacher educators who work in different teaching settings. The insights that emerged based on the qualitative data analysis regarding the use of the tool connect local interpretations with broader interpretations of the research findings.

As evidenced from the data in the reflective reports and the semi-structured interviews, the research participants valued collectively learning new technology knowledge and skills in small groups. The use of the TLP-instrument enabled them to reflect on their own technology learning process with other colleagues. However, the teacher educators indicated that working together in groups should be more learner-centred. As discussed in Chapters 5 and 6, the participants indicated that working in groups only contributes to meaningful technology learning when it includes individual learners' interests and learning needs to create effective bridges for learning new ICT knowledge and skills. Additionally, the participants suggested that learning collectively only contributes to effective learning when it is domain-centred or knowledge-centred. Teacher educators' technology learning should focus on expanding their knowledge and skills that are related to their teaching practice.

The findings in this research only partly corroborate the findings in the literature as discussed in Chapter 2. Several studies on learning in groups (Parker & Chao, 2007; Dillenbourg et al., 2009; Barkley et al., 2014) emphasise that the aim of learning in groups is mostly based on a mutual or shared-problem solving approach. However, based on the analysis of the qualitative data, teacher educators indicated that effective technology learning should be a combination of conducting their learning with some guidance and reflecting on their own

learning experiences with colleagues. A prerequisite in the customisation process of professional development trajectories is to consider teacher educators' preferred learning methods. As the TLP-instrument matured during the separate research phases, insights about the use of the TLP-instrument as well as insights about educators' technology learning emerged which contributed to a more profound understanding of CTPD in different learning settings.

High-level conceptual understanding

As evidenced from the data in the reflective reports and semi-structured interviews, high-level understanding might synthesise middle-range understanding concerning the use of the TLP-instrument as an intervention tool that aims for a more profound understanding of teacher educators' technology learning in a broader perspective.

The description and explanation of preferred combined learning modes and related learning activities can be seen as a contribution to the conceptual understanding of teacher educators' technology learning in the workplace because some studies (Kwakman, 2003, Lohman, 2005; Vermunt, 2005; Commission of the European Communities, 2006) consider learning as a single activity. Based on the analysis of reported learning experiences, it can be concluded that technology learning occurs when sequences of combined learning activities are available. Mapping preferred ways of learning and related activities raises not only teacher educators' awareness about their preferred combined learning modes, it also provides a means for discussing their preferred learning with others based on different needs in various settings. The findings in this research suggest that the TLP-instrument could therefore be useful to teacher educators at other teacher education institutions.

Teacher educators learn the necessary technology knowledge and skills through a combination of conducting their own inquires, experimenting with a variety of activities, and practising the use of ICT with some formal guidance. Additionally, this research demonstrates that opportunities to reflect on their own ideas, thoughts, and experiences are critical components that contribute to the process of meaningful learning, which might foster curricular ownership and in turn might contribute to the uptake of ICT in practice.

The design and development of the TLP-instrument as a tool to map technology learning preferences in this research which is based on the findings from this investigation at a Dutch teacher educational institution can be useful for other teacher education institutions in which educators need support in their technology professionalisation trajectories. Based on the qualitative data in this research educators indicate that using the TLP-instrument enables them to map their personal technology learning preferences which makes it easier to choose specific learning activities in response to the situation.

The research also found that helping teacher educators acquire the necessary knowledge and skills requires an approach that focusses on ongoing relationships. Professional development should therefore be considered as a continual process of experimenting, exchanging ideas and experiences, and reflecting on activities that worked and those that did not. To learn how emerging technologies can be integrated into their teaching practice, teacher educators should be provided with sustained professionalisation opportunities which are tied to the curriculum. Teacher education institutions can help expand this focus by supporting technology professional development programmes that concentrate on using emerging technologies that fit the individual's needs.

7.4 Limitations

As discussed in Chapter 3, design-based research has the potential for developing a better understanding of teacher educators' technology learning yet, there are several challenges and dilemmas that limit the conclusions of this research.

Design-based research strives to balance local effectiveness with specific design principles and the development of a new theory or theories (Wang & Hannafin, 2005) in natural settings. Generalisations of findings are therefore difficult to make (Brown, 1992; Dede, 2004; Anderson & Shattuck, 2012). According to Shaughnessy et al. (2000), generalisability is defined as the extrapolation of the findings to other contexts which have different characteristics and which make it possible to formulate predications or outcomes about recurring practice. However, the very nature of design-based research, in which adjustments are made to the process of intervention(s) and to the construct itself, make it very challenging to distinguish the relevant and successful features. In this research, generalisations are therefore difficult to

make, in the sense that the research context is not 'natural' because it is a joint effort of teacher educators who normally would not work, participate or collaborate so closely with the researcher or other teacher educators. As a result, this research mainly focusses on achieving a fundamental conceptual understanding of technology learning preferences in the workplace.

Another aspect of this research that limits the scope of the conclusions concerns the type of data which has been collected and analysed. Several qualitative and quantitative methods were used with the aim of generating a more accurate and adequate understanding of teacher educators' technology learning preferences than would be possible with one type of approach. Seeking convergence and corroboration of results from different methods and designs that investigate the same social phenomena such as teacher educators' learning preferences enhances the strength and validity of the research findings. The researcher who participated in the design, implementation and evaluation process might find him or herself in a dilemma based on conflicting roles. Being a participant contributes to a better understanding of teacher educators' technology learning preferences, but being involved in the design process might raise methodological concerns which can be summarised as a tendency to be selectively attentive to data that conform to the researcher's expectations. This dilemma became particularly acute when certain portions of the edited transcripts of the interviews with teacher educators and portions of the panel review transcripts were selected and used to illustrate a particular theoretical aspect of teacher educators' technology professionalisation. By trying to promote objectivity based on the commitment to using design interventions to generate conceptual contributions while attempting to facilitate the intervention process, a design-based researcher finds him or herself "in dual roles of advocate and critic" (DBRC, 2003: 7).

7.5 Implications and suggestions for future research and practice

The implications of the investigation in this research are conceptually and practically oriented. In this section, these implications are discussed and some suggestions are presented for future research on teacher educators' technology learning in the workplace.

The TLP-instrument was designed and developed according to the characteristics of formality and collectivity in technology learning. The instrument aims to provide teacher educators with a way to map their preferred learning activities based on contextual learning

needs that will help them to improve their own technology professionalisation. Because the instrument can be used in different learning contexts based on changing needs, the instrument is not intended to be used only once. The instrument aims to strengthen technology learning strategies for reflective practice as a professional habit. Teacher educators indicated that they prefer different learning methods and activities depending on the learning situations. Various learning activities such as working with colleagues, experimenting with new technologies or observing colleagues using emerging technologies in the classroom are all directly related to workplace learning. Using the TLP-instrument might stimulate teacher educators to reflect on their preferred technology learning methods and activities. In this way, they might be able to reflect on their own teaching practice and make informed decisions to improve their practice.

As secondary and tertiary educational institutions have experienced profound changes in their primary and secondary processes of education and organisation, schools, colleges and universities are gaining more autonomy. One result of these changes is that issues of teacher professionalism are contested at both the policy and practice levels (Sachs, 2001), which places more demands on teachers and schools to utilise emerging technologies in teaching and learning. Teachers need to examine the potential pedagogical benefits and opportunities of using emerging technologies in teaching and learning. Teachers are expected to facilitate learning that meets the 21st century learners' wishes and needs in a global knowledge-based society. Therefore, a promising area for further research concerns the ways in which student teachers and teachers can use the TLP-instrument in secondary education schools. A research question could therefore be formulated as follows: In what ways can the TLP-instrument be optimised to support secondary school teachers and student teachers?

Helping teacher educators to use ICT effectively in the classroom may be an important step in the process of assuring that the integration of ICT in educational contexts will be realised. A promising area for further research would therefore focus on the link between teacher educators' technology professional development activities in the workplace and the human resource policies of teacher education institutions. Human resource management and management boards of schools and educational institutions focus on achieving organisational or institutional goals concerning ICT, which attempt to change individuals' behaviours to match the organisational needs (Nishii & Wright, 2008; Kehoe & Wright, 2013). Consequently,

professionalisation programmes are designed and developed in accordance with organisational needs. The question that arises is to what extent do these traditional programmes support teacher educators' individual technology learning and which facilitating factors correspond to their individual learning preferences? It would therefore be useful to investigate the possibilities of different technology learning activities based on the learner's needs compared to traditional professionalisation programmes that are generally governed by strategic organisational needs. Finally, the question could be raised of whether formal assessment procedures concerning teacher educators' technology professionalisation are sufficient, or whether informal assessment procedures might be an appropriate complement to formal methods. By aligning individual technology learning preferences and assessment procedures with organisational or institutional support, different methods of delivering technology professional development may be explored that are beneficial to the teacher educator, the educational institution, and foremost to tomorrow's teachers.

Appendices

(Appendix 1 starts with an introductory letter which explains the purpose of the web-based questionnaire to the research participants and which is then followed by the actual questionnaire that was used during the preliminary research phase.)

Appendix 1

Enquete technologische professionele ontwikkeling van lerarenopleiders op de werkplek

Beste collega,

De laatste tijd zijn door VELON en door diverse opleidingsinstituten activiteiten in gang gezet die een verdere professionele ontwikkeling van lerarenopleiders beogen. In het bijzonder gaat het hier om de verder ontwikkeling van de beroepsregistratie en om opleidingstrajecten voor lerarenopleiders maar ook steeds meer op het gebied van ICT kennis / vaardigheden en digitale didactiek.

Uiteraard is het de bedoeling dat deze activiteiten aansluiten bij de vragen en behoeften van de beroepsgroep lerarenopleiders en dat ze ook onderling goed op elkaar aansluiten. Het in kaart brengen van behoeften en wensen m.b.t. technologische professionalisering is een eerste stap.

In het kader van mijn promotietraject naar technologische professionalisering van lerarenopleiders zou ik het zeer op prijs stellen als u deze enquête **voor 11 oktober** a.s. wilt invullen. Het kost u ca. 10 minuten.

Bij voorbaat hartelijk dank voor uw medewerking,

Maurice Schols
Team Engels/Duits
(Lectoraat: Professionaliteit van de beroepsgroep leraren en lerarenopleiders)

Voor nadere informatie met betrekking tot deze enquête kunt u terecht bij:
m.schols@fontys.nl

A. Algemeen (demografische gegevens)

1) Bent u?

Man	0
Vrouw	0

2) Wat is uw leeftijd?

……..

3) Wat is uw hoogst genoten opleiding?

HBO-Bachelor (incl. PABO / tweedegraads HBO)	0
HBO-Master	0
WO-Bachelor	0
WO-Master	0
PhD / gepromoveerd	0
Anders nl.	0

4) Bij welk team bent u werkzaam?
Bijvoorbeeld: *Engels / Duits*

…….

5) Hoeveel jaren geeft u al les (zowel op de lerarenopleiding als elders)?

…….

B. Geef bij de vragen 6 t/m 12 voor uzelf aan of u het eens bent met de volgende uitspraken (in de context van ICT kennis en vaardigheden)

		Ja	**nee**
6)	Het zelfstandig kunnen werken aan ICT kennis en vaardigheden bevordert mijn leerproces.	0	0
7)	Ik vind het niet nodig om mijn geleerde ICT kennis en vaardigheden te certificeren	0	0
8)	Leren dat ingebed is in een persoonlijke leercontext stimuleert mijn leerproces	0	0
9)	Het heeft mijn voorkeur als het leren van ICT kennis en vaardigheden is afgestemd op mijn persoonlijke leervraag	0	0
10)	Het opdoen van ICT kennis en vaardigheden is voor mij een proces van onbepaalde tijd. Ik geef daarom de voorkeur aan 'lifelong learning'.	0	0
11)	Ik vind het persoonlijk prettig om een cijfer toegekend te krijgen voor het bereiken van de leerdoelen.	0	0
12)	Het samenwerken met collega's aan ICT kennis en vaardigheden heeft mijn voorkeur boven individueel leren.	0	0

C. Geef bij de vragen 13 t/m 16 aan welke uitspraak het beste overeenstemt met uw mening.

Wanneer ik mijn kennis en vaardigheden op het gebied van Informatie en Communicatie Technologie (ICT) wil verbeteren dan ...

13) Ben ik meer gemotiveerd wanneer er een vaststaand curriculum is. 0
Maakt het mij niet uit of er een vaststaand curriculum is 0
Ben ik minder gemotiveerd wanneer er een vaststaand curriculum is. 0

14) Ben ik meer gemotiveerd wanneer er een expert / deskundige aanwezig is. 0
Maakt het mij niet uit of er een expert / deskundige aanwezig is. 0
Ben ik minder gemotiveerd wanneer er een expert / deskundig aanwezig is. 0

15) Geef ik de voorkeur aan externe, vastgestelde leerdoelen 0
Maakt het mij niet uit of er externe, vastgestelde leerdoelen zijn. 0
Geef ik niet de voorkeur aan externe, vastgestelde leerdoelen. 0

16) Geef ik de voorkeur aan de afwezigheid van een vastgestelde kennisbasis. 0
Maakt het mij niet uit of er een vastgestelde kennisbasis is. 0
Geef ik niet de voorkeur aan de afwezigheid van een vastgestelde kennisbasis. 0

D. Geef aan bij vragen 17 t/m 29 in hoeverre u het eens bent met de uitspraken. (In de context van ICT kennis en vaardigheden).

	Mee oneens		**Geen mening**		**Mee eens**
17) Het werken in groepen met collega's aan ICT kennis en vaardigheden ondersteunt mijn leerproces.	0	0	0	0	0
18) Ik geef de voorkeur aan het leren uit boeken, tijdschriften en het bekijken van demo of instructiefilms op het Internet om zo mijn ICT kennis en vaardigheden te verbeteren.	0	0	0	0	0
19) Ik geef de voorkeur aan het consulteren van collega's die meer ICT onderlegd zijn.	0	0	0	0	0
20) Ik bepaal graag zelf wanneer en waar ik leer.	0	0	0	0	0
21) Het studeren voor een certificaat of diploma motiveert mij.	0	0	0	0	0
22) Ik vind het fijn om te leren met persoonlijke coaching.	0	0	0	0	0
23) Persoonlijk geef ik geen voorkeur aan vooraf vastgestelde leerdoelen m.b.t. mijn eigen leerproces.	0	0	0	0	0

24) Het bestuderen van een vastgestelde ICT basiskennis en vaardigheden heeft mijn voorkeur.	0	0	0	0	0
25) Leren op eigen initiatief heeft mijn voorkeur boven gestuurd leren.	0	0	0	0	0
26) Mijn leerproces m.b.t. ICT kennis en vaardigheden hoeft niet plaats te vinden vanuit een context, een bepaald probleem of thema.	0	0	0	0	0
27) Het bestuderen van een vastgestelde ICT basiskennis en vaardigheden heeft mijn voorkeur.	0	0	0	0	0
28) Ik vind het prettig als mijn ICT leerproces qua tijd afgebakend is (er is een duidelijk startmoment en eindmoment).	0	0	0	0	0
29) Persoonlijk geef ik de voorkeur aan het ontbreken van een toetsingsmoment aan het einde van het leerproces.	0	0	0	0	0

30) Het leren van ICT kennis en vaardigheden doe ik het liefst

……

……

E. Ter afronding

	Ja	**nee**
31) Mogen we u later eventueel benaderen voor een kort interview in het kader van uw technologische, professionele ontwikkeling als lerarenopleider?	0	0
32) Wilt u persoonlijk op de hoogte blijven van ICT opleidingstrajecten voor lerarenopleiders?	0	0
33) Wilt u persoonlijk op de hoogte blijven van de uitkomsten van dit onderzoek?	0	0

34) Indien u vraag 31, 32, of 33 met 'ja' hebt beantwoord, verzoeken we u vriendelijk uw e-mail adres hieronder te vermelden.

……

……

Graag wil ik u danken voor het invullen van deze enquête. Wanneer u zometeen verder klikt wordt u naar een pagina geleid met reclame van de enquête provider. U kunt na het zien van de pagina gerust verder gaan met uw werkzaamheden (uw data is beveiligd weggeschreven).

Appendix 2

Semi-structured interviews (Preliminary design-based research phase)

(Appendix 2 is the interview guide that was used during the preliminary research phase. The interview guide is in English because several colleagues who participated in the interviews were not native Dutch. They preferred English as the language to communicate during the interviews.)

Interview protocol questions

Introduction

First I am going to ask you some questions about your personal background and some general demographic questions, to enable comparison with other interviewees. Next we will talk about your formal learning activities and processes. Then we will discuss your informal learning. There are no right or wrong answers; and if there are questions you do not want to answer, then that's ok.

A. Questions about personal background

1) Sex:
   Man 0
   Woman 0

2) What year were you born?

   ……

3) What is your highest qualification / degree?

   Bachelor 0
   Master 0
   Research-Bachelor 0
   Research-Master 0
   PhD 0
   Other …….

4) What is the title of your degree?
   (e.g. MSc in Educational Psychology)

   ……..

5) What is your present position?

   ……..

6) How many years have you been at your current job?

   ……

B. Questions about formal learning (collective and individual)

First, let's talk about **FORMAL LEARNING**, learning activities or processes such as (electronic or written) courses, workshops or training related to your technology professionalisation as a teacher educator.

1) During the past few years were there any formal training or courses on technology professionalisation that you took or wanted to take to improve your ICT knowledge and skills?
2) How useful were these formal technology training, workshops and courses to you as a teacher educator with regard to

   a. … feeling more confident about using ICT in the classroom?
      very helpful 0
      fairly helpful 0
      not helpful 0
   b. … being able to provide students with IVT enriched learning environments?
      very helpful 0
      fairly helpful 0
      not helpful 0
   c. … improving ICT skills and knowledge to the requirements of the job as a teacher educator?
      very helpful 0
      fairly helpful 0
      not helpful 0

3) What is your general assessment with regard to how well designed the formal technology courses, training, workshops are?
4) Are you planning to take any formal training with regard to ICT knowledge and skills in the next weeks or months?
5) If you could choose, would you prefer to have formal courses or workshops that provide you with ICT knowledge and skills which have a broad applicability and are decontextualized?
6) Are pre-set learning objectives with regard to technology professionalisation helpful when acquiring ICT knowledge and skills on your own?
7) Do you prefer to take technology courses with other colleagues?
8) Do you think that a combination of pre-set courses and collaborating in groups / teams will improve your technology knowledge and skills?
9) How important is a formal learning context to you while learning technology knowledge and skills?
10) If you could choose, what sort of learning would you prefer? Please, tell me which sequence you prefer to learn?
    a. individual learning in formal learning contexts;
    b. collective learning in formal learning contexts.

C. Questions about informal learning (collective and individual)

The second part of this interview is about **INFORMAL LEARNING**, learning activities or processes which take place outside of courses, workshops or training related to your technology professionalisation as a teacher educator.

1) During the past few weeks, months were there any informal learning activities, moments outside formal or organised courses, workshops, training or courses that were helpful to you?
2) To what extent has informal learning been helpful to you as teacher educator with regard to …

a…. feeling more confident about using ICT in the classroom?

very helpful 0
fairly helpful 0
not helpful 0

b… being able to provide students with IVT enriched learning environments?

very helpful 0
fairly helpful 0
not helpful 0

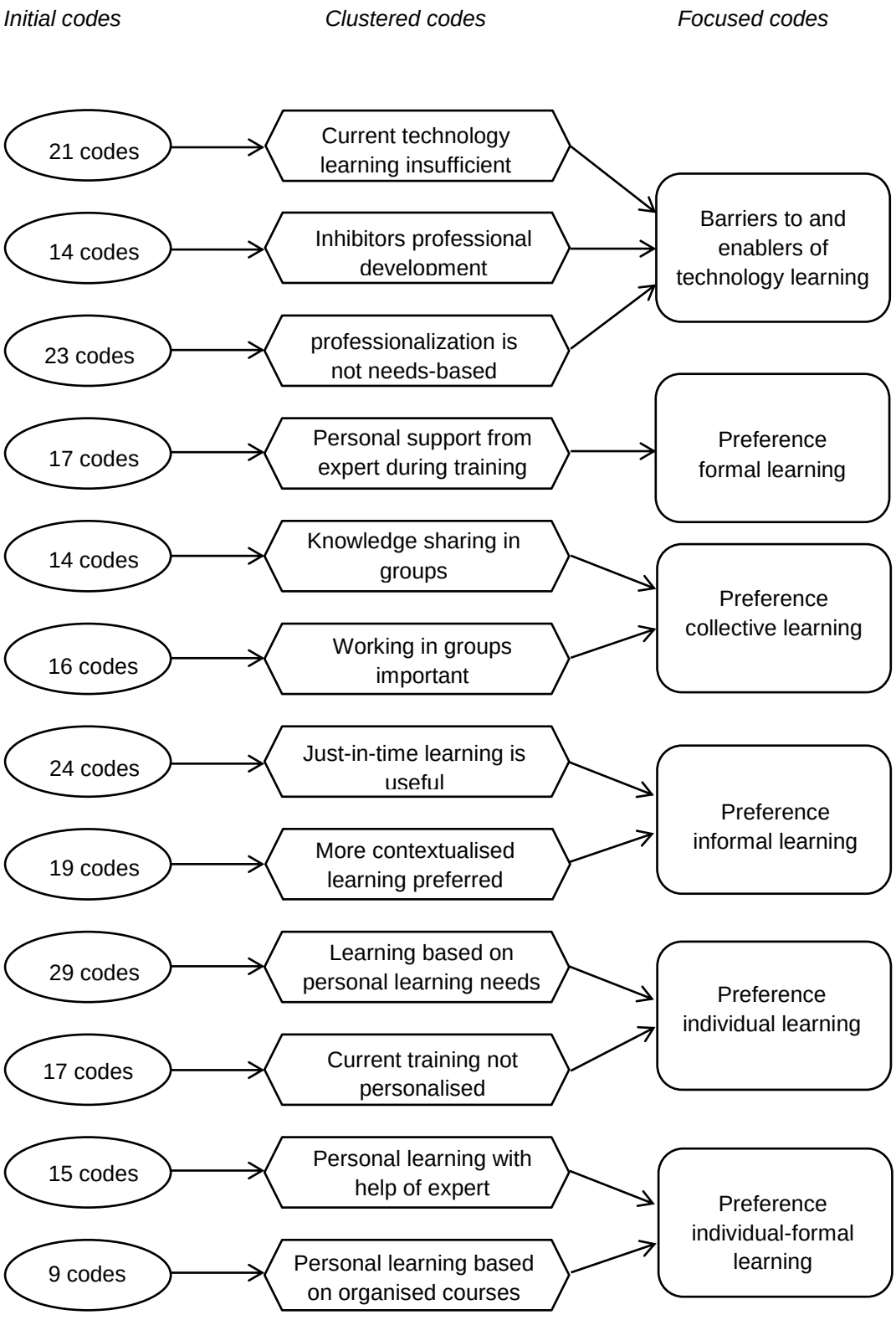
c… improving ICT skills and knowledge to the requirements of the job as a teacher educator?

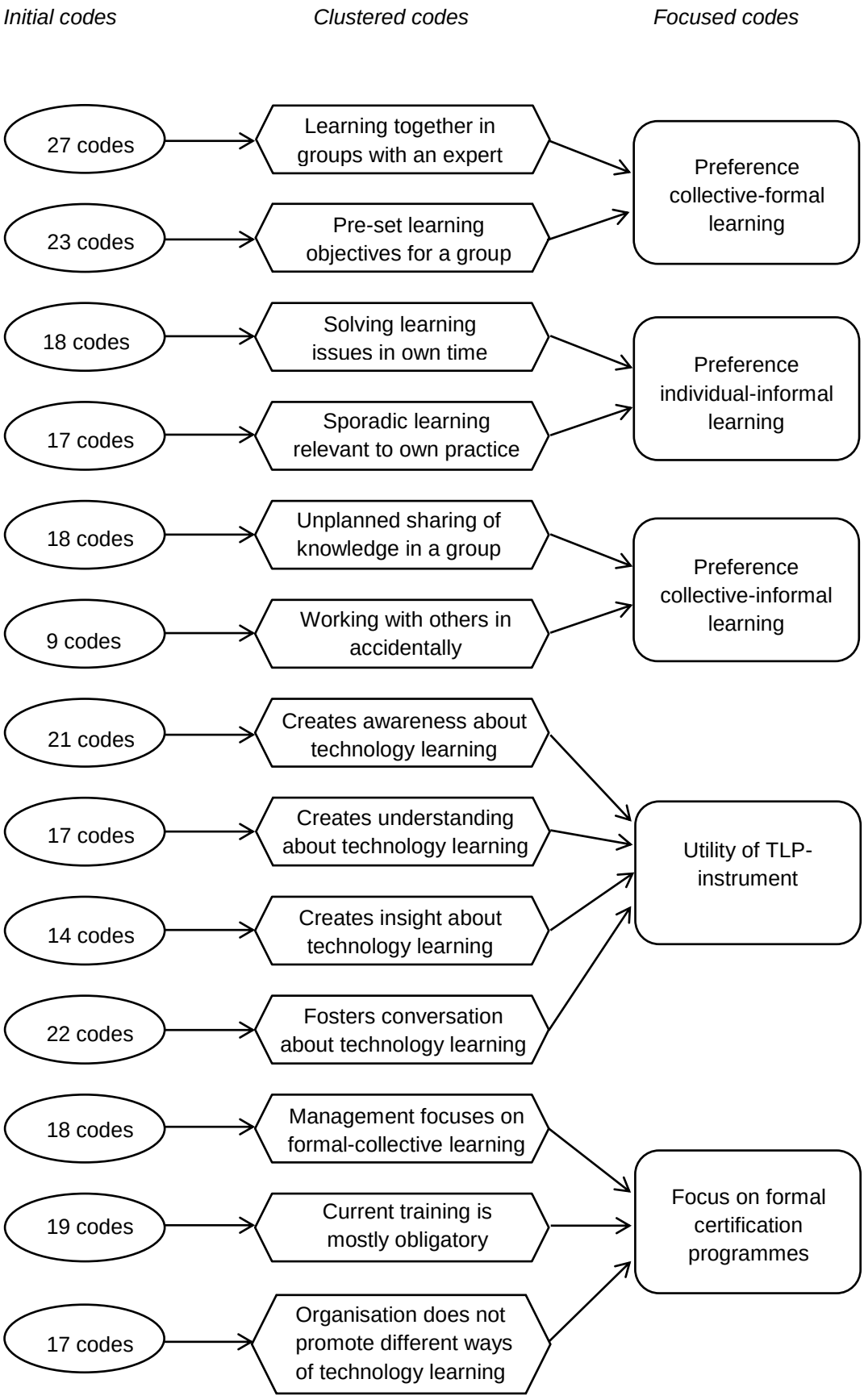
very helpful 0
fairly helpful 0
not helpful 0

3) Do you prefer to collaborate in teams to improve your ICT knowledge and skills without having pre-set learning objectives or required learning outcomes?
4) Could you state about how many hours of informal learning is related to your technology professionalisation; about how many hours in a week? (best guess).
5) How important is it to you to have informal learning moments with other colleagues?
6) Do you think that during informal moments working together with other colleagues will improve your technology knowledge and skills?
7) Could you state what sort of informal technology learning has improved your technology knowledge and skills?
8) Please comment on the following statement:
   Working on my own without hardly any time constraints of formal learning courses or workshops does improve my ICT knowledge and skills.
9) If you could choose, what sort of learning would you prefer? Please, tell me which sequence you prefer to learn?
   a. individual learning in informal learning contexts;
   b. collective learning in informal learning contexts

Appendix 3

Overview of clustered codes and focused codes




Initial codes
Clustered codes
Focused codes
27 codes
Learning together in groups with an expert
23 codes
Pre-set learning objectives for a group
Preference collective-formal learning
18 codes
Solving learning issues in own time
17 codes
Sporadic learning relevant to own practice
Preference individual-informal learning
18 codes
Unplanned sharing of knowledge in a group
9 codes
Working with others in accidentally
Preference collective-informal learning
21 codes
Creates awareness about technology learning
17 codes
Creates understanding about technology learning
14 codes
Creates insight about technology learning
22 codes
Fosters conversation about technology learning
Utility of TLP-instrument
18 codes
Management focuses on formal-collective learning
19 codes
Current training is mostly obligatory
17 codes
Organisation does not promote different ways of technology learning
Focus on formal certification programmes

Appendix 4

Expert panel review questions

(Appendix 4 starts with a short introduction which explains the purpose of the expert review questions with regard to the TLP-questionnaire. It is then followed by the 48 questions that belong to the TLP-questionnaire.)

Beste panel lid,

Hoe kunnen we meer aansluiten bij de technologische leer behoeften van lerarenopleiders? Welke specifieke leerpreferenties spelen een belangrijke rol in het verwerven van ICT kennis en vaardigheden? Op welke wijze kunnen we een instrument ontwikkelen dat per leersituatie gebruikt kan worden om in kaart te brengen welke leerpreferenties in de gegeven context de voorkeur hebben van de leerder?

Om deze vragen te beantwoorden zijn de uitkomsten van een grondige literatuurstudie en een praktijk gerelateerde voorstudie gebruikt voor de ontwikkeling van een prototype instrument. Het instrument bestaat uit een itemlijst. De items zijn ondergebracht in 4 leerpreferentie domeinen, te weten:

1) Formele, technologische leerpreferenties
2) Informele, technologische leerpreferenties
3) Individuele, technologische leerpreferenties
4) Collectieve, technologische leerpreferenties

Op basis van de uitkomsten van de review panel zullen items aangepast worden dan wel weggelaten worden. De volgende vragen dienen meer als ondersteuning tijdens het beoordelingsproces van de items. Indien je opmerkingen hebt en /of andere criteria hebt gebruikt tijdens de beoordeling verzoek ik je deze in het laatste tekstblok te vermelden en indien van toepassing te onderbouwen.

1a. Algemene vragen m.b.t. de items in de vragenlijst
Opmerkingen aangaande *ambivalentie, technische terminologie, negatieve vraagstelling etc.* (Indien van toepassing, geef dan aan op welke vraag / vragen de opmerking(en) betrekking heeft (hebben)).
1b. Algemene vragen m.b.t. de items in de vragenlijst
Opmerkingen aangaande *(te) sturende vragen, te lange vragen, meer dan een vraag, onduidelijke vraagstelling voor respondent etc.* (Indien van toepassing, geef dan aan op welke vraag / vragen de opmerking(en) betrekking heeft (hebben).
2. Algemene vragen m.b.t. de items in de vragenlijst
Opmerkingen aangaande de inhoudelijke vraagstelling. Komt het item in de vragenlijst overeen met het leerdomein waaronder het is ingedeeld? Indien je meent dat het item in een andere leerpreferentie domein thuishoort, kun je dit dan toelichten? Bijvoorbeeld item X valt onder leerpreferentie domein *formeel leren* maar heeft eigenlijk betrekking op *informeel leren* omdat …
3. Algemene vragen m.b.t. de items in de vragenlijst
Indien je overige opmerkingen wilt maken m.b.t. de vragenlijst verzoek ik je deze hieronder te vermelden.

No.	Item (FORMEEL)
1	Ik geef de voorkeur aan vooraf vastgestelde leerdoelen en competenties om ICT kennis en vaardigheden te verwerven.
2	Ik geef de voorkeur aan klassikaal onderwijs om zo ICT kennis en vaardigheden te verwerven.
3	Ik geef de voorkeur aan het verwerven van ICT kennis en vaardigheden binnen een vastgestelde tijdsspanne.
4	Ik geef de voorkeur aan het verwerven van ICT kennis en vaardigheden op basis van modulair onderwijs.
5	Ik geef de voorkeur aan het afronden van een cursus en / of workshop door middel van een erkend diploma of certificaat.
6	Ik geef de voorkeur aan een leraar of expert m.b.t. ICT kennis en vaardigheden die mijn leerproces en / of vorderingen bewaakt.
7	Ik geef de voorkeur aan onderwijs dat systematisch is opgebouwd en georganiseerd.
8	Ik geef de voorkeur aan het volgen van workshops en / of cursussen m.b.t. het verwerven van ICT kennis en vaardigheden die aangeboden wordt door erkende onderwijsinstellingen.
9	Ik geef de voorkeur aan het verwerven van ICT kennis en vaardigheden die algemeen toepasbaar zijn.
10	Ik geef de voorkeur aan het verwerven van ICT kennis en vaardigheden die door een expert of leraar worden aangereikt.
11	Ik geef de voorkeur aan het verwerven van ICT kennis en vaardigheden die regelmatig door een expert of leraar getoetst worden.
12	Ik geef de voorkeur aan het verwerven van ICT kennis en vaardigheden op basis van gestandaardiseerde leeropdrachten en / of leeractiviteiten.

No	Item (INFORMEEL)
13	Ik geef de voorkeur aan het verwerven van ICT kennis en vaardigheden op willekeurige momenten.
14	Ik geef de voorkeur aan het verwerven van ICT kennis en vaardigheden op verschillende plekken.
15	Ik geef de voorkeur aan het verwerven van ICT kennis en vaardigheden op basis van dagelijkse praktijkervaringen.
16	Ik geef de voorkeur aan het verwerven van ICT kennis en vaardigheden door middel van advies en tips van collega's, vrienden en familieleden.
17	Ik geef de voorkeur aan het leren van ICT kennis en vaardigheden buiten een erkende onderwijsinstelling.
18	Ik geef de voorkeur aan het leren van ICT kennis en vaardigheden op flexibele manieren.
19	Ik geef de voorkeur aan het verwerven van ICT kennis en vaardigheden dat context specifiek is.
20	Ik geef de voorkeur aan het spontaan verwerven van ICT kennis en vaardigheden.
21	Ik geef de voorkeur aan het verwerven van ICT kennis en vaardigheden op basis van een natuurlijk leer- en ontwikkelproces.
22	Ík geef de voorkeur aan het verwerven van ICT kennis en vaardigheden op basis van incidenteel leren.
23	Ik geef de voorkeur aan het verwerven van ICT kennis en vaardigheden door gebruik te maken van leermogelijkheden die zich in de werksituatie en dagelijkse routine voordoen.
24	Ik geef de voorkeur aan het verwerven van ICT kennis en vaardigheden door begeleiding en ondersteuning van anderen wanneer een situatie of probleem zich voordoet.

No	Item (INDIVIDUEEL)
25	Ik geef de voorkeur aan zelfgestuurd leren m.b.t. het verwerven van ICT kennis en vaardigheden.
26	Ik geef de voorkeur aan het verwerven van ICT kennis en vaardigheden door te observeren hoe anderen het doen.
27	Ik geef de voorkeur aan het zelf voltooien van ICT leergerichte activiteiten.
28	Ik geef de voorkeur aan het verwerven van ICT kennis en vaardigheden op basis van mijn persoonlijke leerbehoeften.
29	Ik geef de voorkeur aan een proces van ICT kennis en vaardigheden verwerven dat ik zelf kan bewaken.
30	Ik geef de voorkeur aan het zelf invullen van mijn ICT ontwikkeling op basis van persoonlijke leerbehoeften en leerdoelstellingen.
31	Ik geef de voorkeur aan het zelf en dus onafhankelijk verwerven van ICT kennis en vaardigheden.
32	Ik geef de voorkeur aan het zelf experimenteren met ICT.
33	Ik geef de voorkeur aan zelf gekozen kennisbronnen zoals boeken, Internet, (YouTube) filmpjes met als doel ICT kennis en vaardigheden te verwerven.
34	Ik geef de voorkeur aan het verwerven van ICT kennis en vaardigheden op basis van intrinsieke motivatie.
35	Ik geef de voorkeur aan het verwerven van ICT kennis en vaardigheden door zelf te ontdekken en te leren.
36	Ik geef de voorkeur aan het verwerven van ICT kennis en vaardigheden door te reflecteren op eigen handelen.

NO	Item (COLLECTIEF)
37	Ik geef de voorkeur aan het samenwerken in een groep om ICT kennis en vaardigheden te verwerven.
38	Ik geef de voorkeur aan het werken aan een gezamenlijke leeropbrengst om zo ICT kennis en vaardigheden te verwerven.
39	Ik geef de voorkeur aan peer feedback van groepsleden om ICT kennis en vaardigheden te verwerven.
40	Ik geef de voorkeur aan een leer community waarin de groepsleden gemeenschappelijke leerdoelen hebben.
41	Ik geef de voorkeur aan samenwerkend leren waarin het principe van “het geven en nemen” van ICT kennis en vaardigheden centraal staat.
42	Ik geef de voorkeur aan sociale interactie met gelijkgestemden in een groep om ICT kennis en vaardigheden te verwerven.
43	Ik geef de voorkeur aan face-to-face en / of online groepsgesprekken om zo ICT kennis en vaardigheden te verwerven.
44	Ik geef de voorkeur aan het verwerven van ICT kennis en vaardigheden door actief deel te nemen in sociale leerprocessen met diverse mensen.
45	Ik geef de voorkeur aan het verwerven van ICT kennis en vaardigheden op basis van kennisconstructie met groepsleden.
46	Ik geef de voorkeur aan het verwerven van ICT kennis en vaardigheden door het voltooien van gemeenschappelijke opdrachten.
47	Ik geef de voorkeur aan het verwerven van ICT kennis en vaardigheden op basis van wederzijdse verantwoordelijkheden tussen groepsleden.
48	Ik geef de voorkeur aan het verwerven van ICT kennis en vaardigheden in een groep die een gemeenschappelijke leercontext deelt.

Appendix 5

Questions semi structured interviews (prototype phase II)

(Appendix 5 is the interview guide that was used during the prototype and evaluation phase III. This interview guide is in Dutch because for all respondents that participated in this research phase, Dutch was their mother tongue. The questions focussed on how useful the TLP-instrument was.)

Inleiding:

Controleren van leeftijd, jaren van ervaring, vak dat de geïnterviewde geeft.

Dank voor het feit dat u er mee instemde om deel te nemen aan dit interview. Uw identiteit blijft anoniem en u kunt op ieder willekeurig moment af zien van verdere deelname aan het onderzoek.

U heeft de vragenlijst als onderdeel van het technologische leerpreferenties instrument ingevuld, kunt u mij iets meer vertellen over het gebruik van het instrument ten behoeve van het in kaart brengen van uw technologische leerpreferenties?

Vragen naar aanleiding van het gebruik van het TLP-instrument.

Wat waren uw vermoedelijke leerpreferenties?

In welk opzicht heeft het uw beeld van uw eigen technologische leerpreferenties veranderd na het invullen het gebruik van het instrument?

Heeft het instrument u geholpen bij het inzichtelijk maken van uw technologische leerpreferenties?

Kunt u mij iets meer vertellen over de gekozen technologische leerpreferenties?

Welke leeractiviteiten verbindt u zelf aan de gekozen leerpreferenties?

Komen deze leeractiviteiten overeen met de wijze waarop het technologisch professionaliseren wordt aangeboden op de werkplek?

Het instrument kent twee schalen te weten formeel versus informeel leren en individueel versus collectief leren. Op basis van deze twee schalen ontstaan 4 gecombineerde leerpreferenties. Hoe ervaart u deze twee schalen met vier separate leerpreferenties?

Denkt u dat u met behulp van deze vier leerpreferenties inzichtelijk kan maken wat uw technologische leerpreferenties zijn?

Appendix 6

Reflective reports / semi-structured group interviews / TLP-instrument (Prototype III and evaluation phase)

(Appendix 6 consists of questions that were used during the semi-structured group interviews but which were also used in the reflective reports. Participants filled out the questions individually before discussing the questions in the group. It also consists of the TLP-instrument which consists of the questionnaire with 40 questions, a score card and a graph paper.)

Opdracht blad 1

(Reflective report)

Naam: _____

Team: _____

Datum:_____

1. Kun je in het kort aangeven op welke wijze je het liefste ICT kennis en vaardigheden verwerft?

Je mag nu door naar de vragenlijst (OPDRACHT BLAD 2).

Opdracht blad 2

(Reflective report)

Technologische Leer Preferenties instrument (TLP-instrument)

Deze vragenlijst bestaat uit 4 delen:

1) **Algemene informatie over het TLP-instrument**
2) **Vragenlijst**
3) **Berekening score**
4) **Overzicht grafiek**

DEEL 1. Algemene informatie over het TLP-instrument

De volgende vragenlijst bestaat uit vier sets met 10 vragen. De vragenlijst is onderdeel van een technologisch leerpreferenties instrument (TLP-instrument). Aan de hand van een vragenlijst kunnen we de technologische leerpreferenties inzichtelijk maken. In de vragenlijst worden vragen gesteld met betrekking tot de volgende vier verschillende technologische leerpreferenties waarvan de beschrijving voor dit onderzoek nu volgt:

1. formeel technologische leerpreferentie

Hieronder wordt verstaan technologisch leren dat plaatsvindt in een georganiseerde en gestructureerde omgeving (bijvoorbeeld binnen een erkend instituut, een school, opleidingscentrum) en dat uitdrukkelijk als leren wordt aangeduid in termen van doelstellingen, tijd of middelen. Het leidt doorgaans tot een certificering en / of diploma.

2. informeel technologische leerpreferentie

Hieronder wordt verstaan technologisch leren dat voortvloeit uit de dagelijkse activiteiten die verband houden met het werk. Dit leren is niet of wordt niet georganiseerd of gestructureerd in termen van doelstellingen, tijd of leerondersteuning en het vindt vaak spontaan, terloops plaats buiten opleiders en erkende onderwijsinstituten om.

3. individueel technologische leerpreferentie

Hieronder wordt verstaan technologisch leren dat plaatsvindt binnen leerprocessen die solitair verlopen en waarbij de leerder reflecteert op het geleerde en zelf aanpassingen verricht om de gewenste leerdoelen te bereiken.

4. collectief technologische leerpreferentie

Hieronder wordt verstaan dat technologisch leren plaatsvindt in een sociale context waarbij de (virtuele) groep een dimensie toevoegt aan het leren en / of het leerresultaat van het individu met betrekking tot het verwerven van nieuwe ICT kennis en vaardigheden.

DEEL 2. Vragenlijst

SET 1

Ik geef de voorkeur aan …

No.	Vragen	*Volledig mee oneens*	*Mee oneens*	*nog oneens / nog eens*	*Mee eens*	*Volledig mee eens*
1.	… leerdoelen die vast staan met betrekking tot een leer-traject waarin ICT kennis en vaardigheden verworven worden.					
2.	… het verwerven van ICT kennis en vaardigheden door zelf de leerdoelen te bepalen.					
3.	… het verwerven van ICT kennis en vaardigheden op willekeurige momenten.					
4.	… samen met anderen ICT kennis en vaardigheden te verwerven.					
5.	… het verwerven van ICT kennis en vaardigheden door zelf te reflecteren op leerervaringen.					
6.	… klassikaal onderwijs om zo ICT kennis en vaardigheden te verwerven.					
7.	… verwerven van ICT kennis en vaardigheden door het uitwisselen van verschillende ervaringen met andere groepsleden.					
8.	… het plaats onafhankelijk verwerven van ICT kennis en vaardigheden.					
9.	… het verwerven van ICT kennis en vaardigheden door zelf controle te houden over de leergerichte activiteiten.					
10.	… het verwerven van ICT kennis en vaardigheden in groepsverband waarin deling van kennis en vaardigheden centraal staan.					

SET 2

Ik geef de voorkeur aan …

No.	vragen	*Volledig mee oneens*	*Mee oneens*	*nog oneens / nog eens*	*Mee eens*	*Volledig mee eens*
11.	… het verwerven van ICT kennis en vaardigheden door middel van advies en tips van collega's, vrienden en familieleden.					
12.	…het verwerven van ICT kennis en vaardigheden binnen een vastgestelde tijdsspanne.					
13.	… het verwerven van ICT kennis en vaardigheden als een spontaan leerproces.					
14.	…het verwerven van ICT kennis en vaardigheden door middel van modulair onderwijs.					
15.	… het verwerven van ICT kennis en vaardigheden op basis van mijn persoonlijke leerbehoeften.					
16.	… het verwerven van ICT kennis en vaardigheden door nieuwe informatie van groepsleden te verbinden aan bestaande kennis en vaardigheden.					
17.	… het verwerven van ICT kennis en vaardigheden dat ongemerkt plaatsvindt.					
18.	… het verwerven van ICT kennis en vaardigheden waarbij het samen nadenken over en reflecteren op een probleem centraal staat.					
19.	… het verwerven van ICT kennis en vaardigheden dat ik als leerproces zelf bewaak.					
20.	…het verwerven van ICT kennis en vaardigheden dat bevestigd wordt met een erkend diploma of certificaat.					

SET 3

Ik geef de voorkeur aan …

No.	Vragen	*Volledig mee oneens*	*Mee oneens*	*nog oneens / nog eens*	*Mee eens*	*Volledig mee eens*
21.	… het verwerven van ICT kennis en vaardigheden door zelf te experimenteren.					
22.	… een expert die mijn leerproces en / of vorderingen bewaakt m.b.t. het verwerven van ICT kennis en vaardigheden.					
23.	… het verwerven van ICT kennis en vaardigheden door het werken aan gemeenschappelijke opdrachten.					
24.	… het verwerven van ICT kennis en vaardigheden op basis van een vrijblijvend leerproces.					
25.	… dat leerdoelen bepaald worden door anderen m.b.t. een traject waarin ICT kennis en vaardigheden verworven worden.					
26.	… het verwerven van ICT kennis en vaardigheden door het raadplegen van zelfgekozen kennisbronnen zoals het Internet en / of instructiefilms.					
27.	… het verwerven van ICT kennis en vaardigheden in een groep waarin de groepsleden elkaar actief helpen met het verwerven van nieuwe kennis en vaardigheden.					
28.	… het verwerven van ICT kennis en vaardigheden op basis van een ongepland leerproces.					
29.	… onderwijs m.b.t. het verwerven van ICT kennis en vaardigheden dat een duidelijke structuur heeft.					
30.	… het verwerven van ICT kennis en vaardigheden met collega's binnen mijn eigen team.					

SET 4

Ik geef de voorkeur aan …

No.	**vragen**	*Volledig mee oneens*	*Mee oneens*	*nog oneens / nog eens*	*Mee eens*	*Volledig mee eens*
31.	… het verwerven van ICT kennis en vaardigheden door zelf verantwoordelijk te zijn voor het leerproces.					
32.	… het verwerven van ICT kennis en vaardigheden door gebruik te maken van leermogelijkheden die zich toevallig in de dagelijkse werkzaamheden voordoen.					
33.	… het verwerven van ICT kennis en vaardigheden op basis van een persoonlijke leergierigheid.					
34.	… het verwerven van ICT kennis en vaardigheden door begeleiding en ondersteuning van anderen nadat een situatie of probleem zich voordoet.					
35.	… het verwerven van ICT kennis en vaardigheden samen met andere collega's met eenzelfde leerbehoefte.					
36.	… het verwerven van ICT kennis en vaardigheden die door een expert worden aangereikt.					
37.	… het verwerven van ICT kennis en vaardigheden waarin het gezamenlijk leren bijdraagt aan persoonlijke leerbehoeften.					
38.	… het verwerven van ICT kennis en vaardigheden die regelmatig getoetst worden.					
39.	… het verwerven van ICT kennis en vaardigheden dat ongemerkt plaatsvindt.					
40.	… het verwerven van ICT kennis en vaardigheden dat als leerproces volledig bij mijzelf ligt.					

DEEL 3. Berekening score

Stappenplan voor het berekenen van de score:

1. Tel de scores van iedere vraag.
   Met betrekking tot de Likert schaal geldt dat:
   - mee eens = 1 punt
   - volledig mee eens = 2 punten
2. Tel de punten per leerpreferentie op (totaal 1, totaal 2, etc.)
3. Zet vervolgens de totaalscore uit op de **y-**, en **x-as** (zie grafiek op volgende pagina)

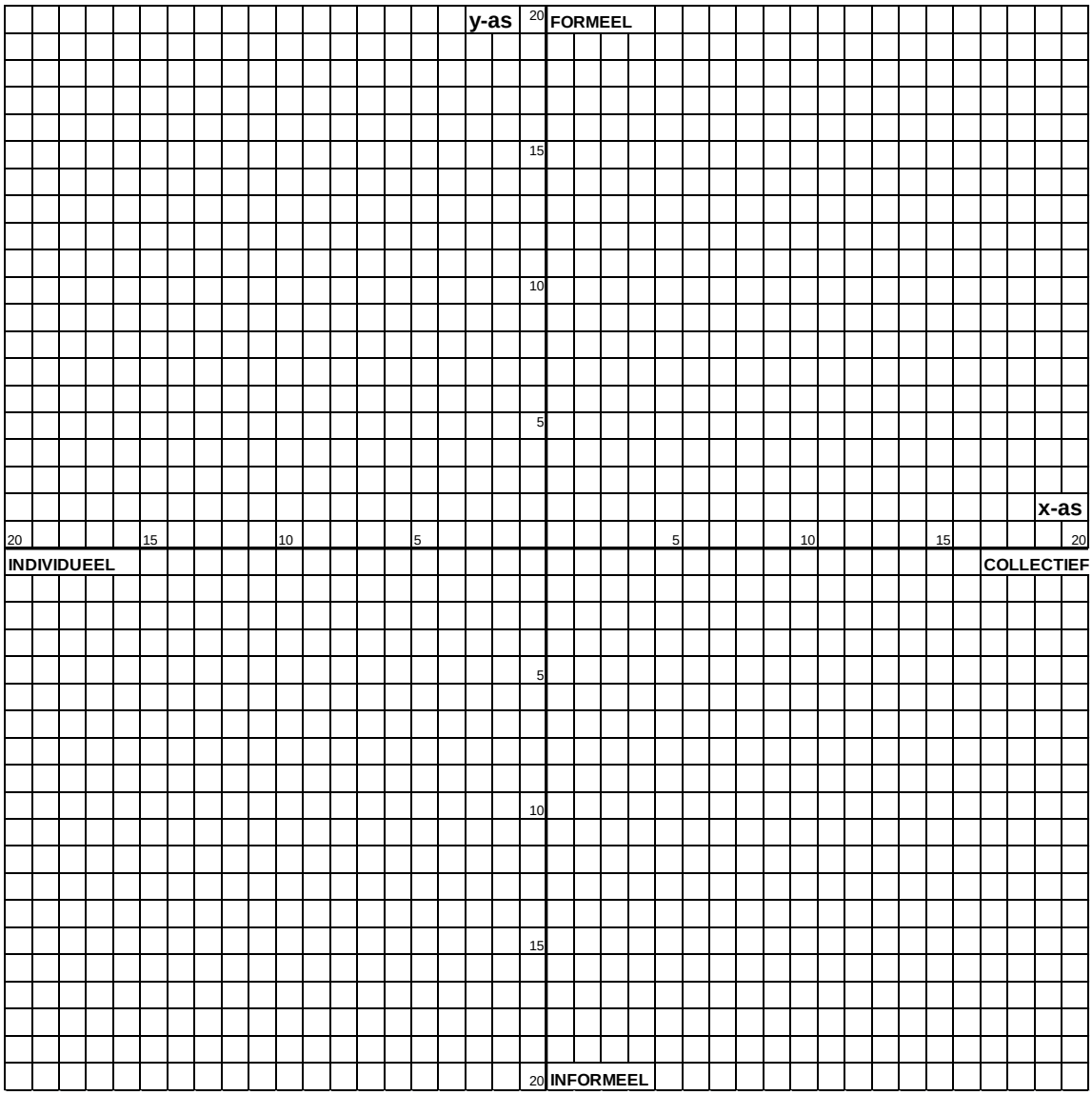
Score lijst

Vraag nummer FORMEEL	**Vraag nummer COLLECTIEF**	**Vraag nummer INFORMEEL**	**Vraag nummer INDIVIDUEEL**
1.	4.	3	2.
6.	7.	8.	5.
12.	10.	11.	9.
14.	16.	13.	15.
20.	18.	17.	19.
22.	23.	24.	21.
25.	27.	28.	26.
29.	30.	32.	31.
36.	35.	34.	33.
38.	37.	39.	40.
Totaal 1:	**Totaal 2:**	**Totaal 3:**	**Totaal 4:**

DEEL 4. Overzicht grafiek

TLP-instrument overzicht grafiek score

Door de totaal scores van de vier technologische leerpreferenties in de grafiek als punten op de **y-** en **x-as** uit te zetten, krijg je een overzicht van jouw persoonlijke leerpreferentie(s). Echter, het is een momentopname en moet meer gezien worden als een indicatieve benadering van preferenties. De technologische leerpreferentie(s) met de meeste voorkeur tref je in het kwadrant / de kwadranten aan waarin de grootste oppervlakte gemarkeerd is.



Opdracht blad 3

(Reflective report)

De volgende vragen worden tijdens het groepsinterview besproken:

1. **A.** Heeft het instrument je geholpen bij het inzichtelijk maken van je technologische leerpreferenties? Licht dit toe!

2. In hoeverre of op welke wijze denk je dat het instrument een bijdrage kan leveren aan je eigen technologisch professionaliseringstraject?

3. Welke leeractiviteiten verbind je zelf aan de gekozen technologische leerpreferenties uit de vragenlijst?

4. **A**. Welke factoren **hinderen** je in je technologische professionalisering op de werkplek?

B. Welke factoren **dragen bij** aan je eigen technologische professionalisering op de werkplek?

A.

B.

5. Algemene opmerkingen suggesties?

Appendix 7

English Version of the TLP-Instrument and reflective reports/ semi-structured group interview protocol

(Appendix 7 consists of questions that were used during the semi-structured group interviews and also used in the reflective reports. Participants filled out the questions individually before discussing the questions in the group. It also contains the TLP instrument, which consists of the 40-item questionnaire, a score card and graph paper.)

Task 1

Reflective Report

Name: _____

Team: _____

Date: _____

2. In the box below, briefly describe how you prefer to acquire ICT knowledge and skills.

You may now continue to Task 2, the questionnaire.

Task 2

Reflective Report

Technology Learning Preferences Instrument (TLP instrument)

The instrument consists of four parts:

5) **Basic information on the TLP-instrument**
6) **Questionnaire**
7) **Score card**
8) **Graph for plotting the scores**

PART 1. Basic Information on the TLP-Instrument

This questionnaire is comprised of four sets of questions; each set consists of 10 questions and represents one learning mode. Responses to the questions in this questionnaire will provide insight into respondents' technology learning style preferences. The four different learning modes are as follows:

1. Formal technology learning preference

Technology learning which takes place in an organised and structured context (for example, within a recognised learning institution, school or training centre) and which has fixed learning objectives, a set timeframe and leads to a certification or award.

2. Informal technology learning preference

Technology learning which takes place in professional practice-related activities, does not follow a specified curriculum and is not often professionally organized but rather originates accidentally, sporadically outside recognized learning institutions, schools or training centres.

3. Individual technology learning preference

Technology learning which takes place individually, as a solitary learning processes, and in which the learner reflects on what he or she has learnt and makes professional practice changes to accomplish desired personal learning objectives.

4. Collective technology learning preference

Technology learning that takes place either face-to-face or virtually in a social context and in which the group of learners contribute to the learning process or outcome(s) of the individual with regard to the acquisition of new ICT knowledge and skills.

PART 2. Questionnaire

Please use check marks, X's to designate your choice. Make sure that they are placed squarely within the boxes.

SET 1

I prefer …

No.	Questions	*Strongly Disagree*	*Disagree*	*Undecided*	*Agree*	*Strongly Agree*
1.	… fixed learning objectives in learning situations where ICT knowledge and skills are acquired.					
2.	… to obtain ICT knowledge and skills based on self-defined learning objectives.					
3.	… to acquire ICT knowledge and skills at random moments.					
4.	… to acquire ICT knowledge and skills together with other learners.					
5.	… to acquire ICT knowledge and skills through self-reflection on learning experiences.					
6.	… to acquire ICT knowledge and skills in a recognised learning institution.					
7.	… to acquire ICT knowledge and skills by exchanging experiences with other learners in a group.					
8.	… to acquire ICT knowledge and skills in any location.					
9.	… to acquire ICT knowledge and skills and having full control over the learning activities.					
10.	… to acquire ICT knowledge and skills within a group specifically designed to foster knowledge and skills.					

SET 2

I prefer …

No.	Questions	*Strongly Disagree*	*Disagree*	*Undecided*	*Agree*	*Strongly Agree*
11.	… to acquire ICT knowledge and skills based on tips and advice from colleagues, friends, and relatives.					
12.	… to acquire ICT knowledge and skills within a fixed time span.					
13.	… to acquire ICT knowledge and skills spontaneously, while trying to solve a problem?					
14.	… to acquire ICT knowledge and skills by completing a fixed set of modules.					
15.	… to acquire ICT knowledge and skills based on my personal learning needs.					
16.	… to acquire ICT knowledge and skills based on new information from other learners in a group setting'?					
17.	… to acquire ICT knowledge and skills that takes place accidentally.					
18.	… acquiring ICT knowledge and skills by reflecting on an identified problem with other learners in a group.					
19.	… to acquire ICT knowledge and skills as a learning process which I monitor.					
20.	… to acquire ICT knowledge and skills which leads to certification or an award.					

SET 3

I prefer …

No.	Questions	*Strongly Disagree*	*Disagree*	*Undecided*	*Agree*	*Strongly Agree*
21.	… to acquire ICT knowledge and skills by experimenting on my own.					
22.	… to acquire ICT knowledge and skills by learning from an expert who monitors my understanding and skills acquisition.					
23.	… to acquire ICT knowledge and skills through group tasks.					
24.	… to acquire ICT knowledge and skills in a way that is unstructured and self-directed.					
25.	… the learning objectives with regard to ICT knowledge and skills be set by others.					
26.	… to acquire ICT knowledge and skills based on a process of self-consultation.					
27.	… to acquire ICT knowledge and skills within a group in which the individuals actively help one another.					
28.	… to acquire ICT knowledge and skills in a way that is unplanned.					
29.	… to learn and acquire new ICT knowledge and skills in a lesson or lessons with clear structure.					
30.	… to acquire ICT knowledge and skills with colleagues.					

SET 4

I prefer …

No.	Questions	*Strongly Disagree*	*Disagree*	*Undecided*	*Agree*	*Strongly Agree*
31.	… to be responsible for my own learning process when acquiring ICT knowledge and skills.					
32.	… to obtain ICT knowledge and skills by making use of learning opportunities that occur by chance.					
33.	… to acquire ICT knowledge and skills based on personal inquisitiveness.					
34.	… to acquire ICT knowledge and skills by making use of the help and support of others when a certain problem occurs.					
35.	… to acquire ICT knowledge and skills together with colleagues who have the same learning needs.					
36.	… to acquire ICT knowledge and skills provided by an expert.					
37.	… to acquire ICT knowledge and skills in settings where learning with others contributes to my personal learning.					
38.	… to acquire ICT knowledge and skills which will be tested on a regular basis.					
39.	… to acquire ICT knowledge and skills which takes place sporadically					
40.	… to acquire ICT knowledge and skills in a way for which I am fully accountable.					

PART 3. Score Card

Procedure to calculate your own individual learning preferences scores:

1. For each question in the questionnaire, transfer the point value for the response to the corresponding cell in the score list below. A response mark of *Strongly Agree* is worth 2 points, *Agree* is worth 1 point.
2. Total the scores in each column for each learning preference to get a total.
3. Plot the total score of each learning preference on the x-axis and on the y-axis of the graph provided in Part 4 of the instrument.

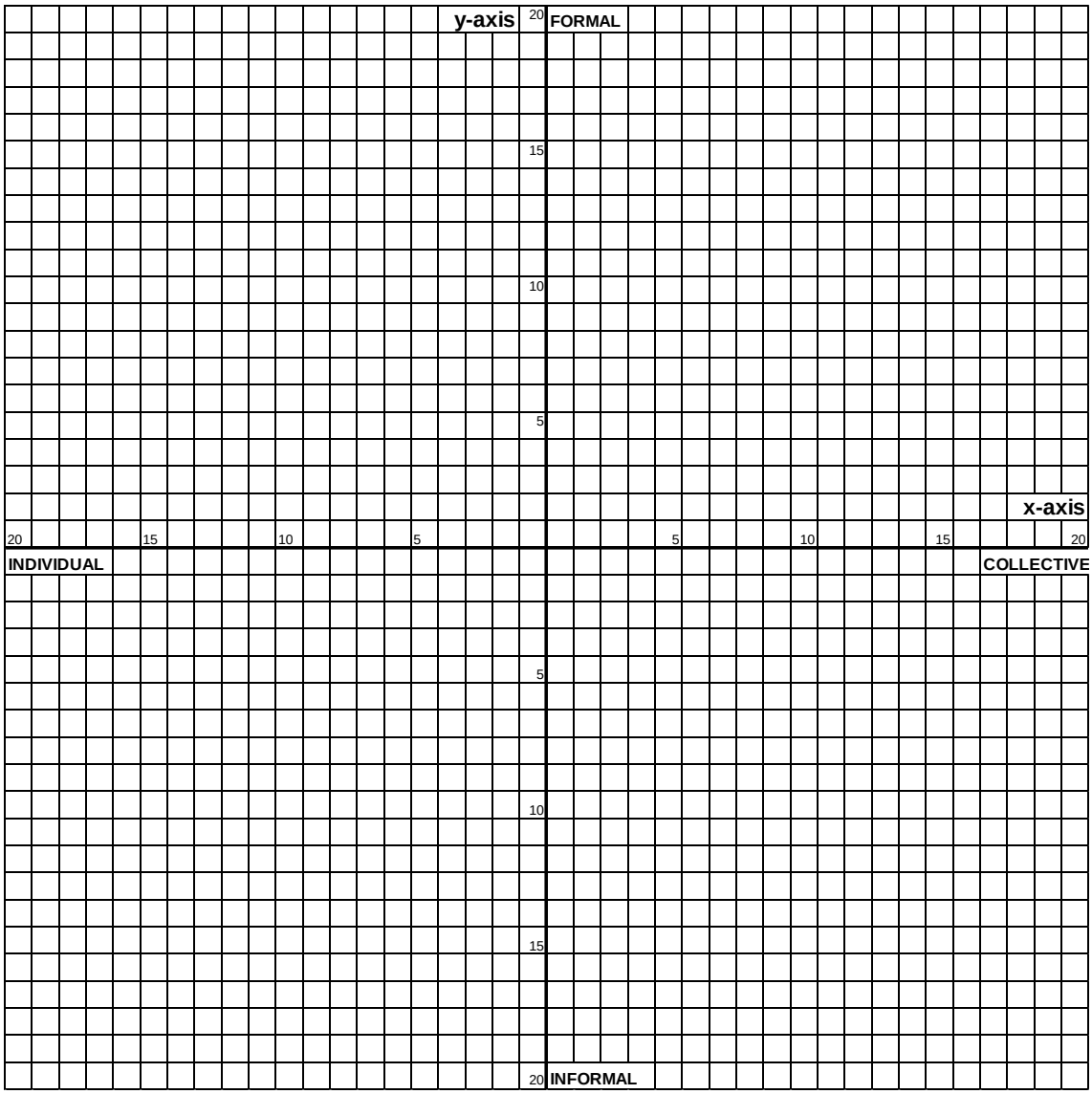
Score list

Question number FORMAL	Question number COLLECTIVE	Question number INFORMAL	Question number INDIVIDUAL
1.	4.	3.	2.
6.	7.	8.	5.
12.	10.	11.	9.
14.	16.	13.	15.
20.	18.	17.	19.
22.	23.	24.	21.
25.	27.	28.	26.
29.	30.	32.	31.
36.	35.	34.	33.
38.	37.	39.	40.
Total 1:	**Total 2:**	**Total 3:**	**Total 4:**

PART 4. Graph Score

Overview of the graph score TLP instrument

Plotting the scores with regard to the four technology learning preferences makes it possible to get an overview of your personal, preferred style. This overview presents a learning preference that applies to this moment or learning situation and therefore should be considered dynamic rather than a fixed, static outcome.



Task 3

Reflective Report

The following questions will be asked during the semi-structured group interviews:

1. To what extent was the TLP instrument helpful in providing insight concerning your technology learning preferences? Please explain!

2. To what extent or in what way do you think the TLP instrument could be helpful in your technology professionalisation process?

3. Based on the information the TLP instrument has provided about your learning style preferences, what sort of learning activities would you expect you benefit from and enjoy?

4. **A**. What factors hinder your professional development in technology use in the workplace?

B. What factors contribute to or help your professional development in technology use in the workplace?

A.

B.

5. General comments/suggestions about the TLP-instrument or what you have gained from it?

Appendix 8

Verklaring van instemming als deelnemer aan het onderzoek

Korte beschrijving van het onderzoek:

Het doel van dit onderzoek is het in kaart brengen van technologische leerpreferenties van lerarenopleiders om zo professionaliseringsprogramma's te ontwikkelen die meer recht doen aan de leerwensen en behoeften van lerarenopleiders. Met behulp van een technologisch leerpreferenties instrument worden niet alleen uw preferenties in kaart gebracht maar ook uw ervaringen en ideeën m.b.t. het gebruik van het instrument in het bepalen van welke leer activiteiten uw prefereert.

Om mijn onderzoek uit te kunnen voeren heb ik lerarenopleiders nodig die de 6 verschillende teams vertegenwoordigen binnen het instituut. De geselecteerde lerarenopleiders worden vervolgens uitgenodigd om hun ervaringen en bevindingen m.b.t. het gebruik van het instrument toe te lichten en welk effect het gebruik heeft op de keuze van bepaalde leeractiviteiten. Het interview zelf zal ongeveer 30 minuten duren.

Uw deelname aan het interview is geheel vrijwillig. Het staat u vrij om op ieder moment uw deelname in te trekken zonder opgaaf van reden. Tevens staat het u vrij om datgene dat u gezegd heeft tijdens het interview te laten verwijderen uit de onderzoek documenten.

Het interview zal worden opgenomen met een digitale voice recorder. De gesproken tekst zal vervolgens worden uitgeschreven. Er zal op geen wijze persoonlijke informatie van u worden vrijgegeven.

De resultaten worden ten behoeve van het onderzoek verwerkt en worden openbaar gemaakt aan de examinatoren. Tevens worden de onderzoeksresultaten in wetenschappelijke journals en / of tijdschriften gepubliceerd. Ook hier is van toepassing dat uw persoonlijke gegevens niet worden vrijgegeven.

Alle informatie wordt vertrouwelijk opgeslagen en wordt zes jaar na het voltooien van het proefschrift en / of publicaties vernietigd en / of digitaal verwijderd.

Naam van de onderzoeker:

Onderzoeker: Maurice Schols
Doctorate student Roehampton University, Londen
Email: m.schols@fontys.nl

Verklaring van instemming:

Hiermee ga ik akkoord met de deelname aan dit onderzoek en ben ik mij bewust van het feit dat ik mij op ieder moment tijdens het onderzoek zonder opgaaf van reden kan terugtrekken. Tevens begrijp ik dat alle informatie op vertrouwelijk wijze door de onderzoeker wordt behandeld en verwerkt en dat mijn identiteit niet herleidbaar is.

Naam: ……..

Handtekening: ..……..….

Datum: ……..

Bibliography:

Adler, P., & Adler, P. (1987) *Membership roles in field research*. Newbury Park, CA: Sage Publications.

Al-Mahmood, R., & Gruba, P., (2007) Approaches to the implementation of generic graduate attributes in Australian ICT undergraduate education. *Computer and Science Education.* (17)3 pp.171-185.

Ally, M. (2004) Foundation of educational theory for online learning. In: Anderson, T. (ed.) *The theory and practice of online learning*. Edmonton: Au Press Athabasca University. pp.3-32.

Anderson, T. & Dron, J. (2011) Three generations of distance education pedagogy. *The International Review of Research in Open and Distributed Learning*. 12(3) pp.80-97.

Anderson, T & Shattuck, J. (2012) Design-based research: A decade of progress in education research. *Educational Researcher.* 41(1) pp.16-25.

Anderson, T., Varnhagen, S., & Campbell, K. (1998) Faculty adoption of teaching and learning technologies: Contrasting earlier adopters and mainstream faculty. *The Canadian Journal of Higher Education.* 28(2-3) pp.71–98.

Andrew, N., Tolson, D., & Ferguson, D. (2008) Building on Wenger: Communities of practice in nursing. *Nurse Education Today*. 28(2) pp.246-252.

Angrosino, M. V. (2005) Recontextualizing observation: Ethnography, pedagogy, and the prospects for a progressive political agenda. In: Denzin, N, & Lincoln, Y. (eds.). *The Sage handbook of qualitative research.* (3rd ed.) Thousand Oaks, CA: Sage. pp.729-745.

Archer, T. (2003) Web-based surveys. *Journal of Extension*. 41(4). Available at: http://www.joe.org/joe/2003august/tt6.php. (Accessed: 24/07/15).

Arthur, M. Waring, R. Coe, & Hedges, L. (2012) *Research methods & methodologies in education*. London: Sage Publishers.

Ashburn, E., & Floden, R. (2006) *Meaningful learning using technology: What educators need to know and do*. New York: Teachers College Press.

Asselin, M. E. (2003) Insider research: Issues to consider when doing qualitative research in your own setting. *Journal for Nurses in Staff Development*. 19(2) pp.99-103.

Balanskat, A., Blamire, R., & Kefala, S. (2006) *A review of studies of ICT impact on schools in Europe*. European Schoolnet. Available at: http://www.oecd.org/edu/ceri/39459069.pdf (Accessed: 28/02/2014).

Bancheva, E., & Ivanova, Maria. (2015) Informal learning in the workplace. *Research on the Education and Learning of Adults*. 3 pp.157-182.

Barab, S., & Squire, K. (2004) Design-Based Research: Putting a Stake in the Ground. *The Journal of the Learning Science.* 13(1) pp.1-14.

Barker, C., & Johnson, G. (1998) Interview talk as professional practice. *Language and Education*. 12(4) pp. 229-242

Barker, D., Quennerstedt, M., & Annerstedt, C. (2013) Inter-student interactions and student learning in health and physical education: a post-Vygotskian analysis. *Physical Education and Sport Pedagogy*. 20(4) pp.409-426.

Barkley, E., Cross, K., Major, C. (2014) *Collaborative learning techniques* (2nd ed.) Hoboken: Wiley & Sons.

Barry, C. (1998) Choosing Qualitative Data Analysis Software: Atlas/ti and NUD.IST Compared. *Sociological Research Online*. 3(3). Available from: http://www.socresonline.org.uk/ socresonline/3/3/4/html (Accessed: 18/09/14).

Baylor, A. & Ritchie, D. (2002) What factors facilitate teacher skill, teacher morale, and perceived student learning in technology-using classrooms? Computers and Education, 39(4), 395-414.

Beckett, D., & Hager, P. (2002) *Life, Work and Learning: Practice in Postmodernity*. London: Routledge.

Bennett, S., Maton, K. & Kervin, L. (2008) The 'digital natives' debate: A critical review of the evidence. *British Journal of Educational Technology*. 39(5) pp.776-786.

British Educational Communications and Technology Agency (Becta) (2004) *A review of the research Literature on barriers to the uptake of ICT by teachers*. Coventry: Becta. Available from: http://www.becta.org.uk (Accessed: 28/09/2013).

British Educational Communications and Technology Agency (Becta) (2008) *Harnessing Technology Review 2008: The role of technology and its impact on education.* Coventry: Becta. Available from: http://www.becta.org.uk (Accessed: 10/02/14).

British Educational Communications and Technology Agency (Becta) (2009) *The impact of digital technology: A review of the evidence of the impact of digital technologies on formal education.* Coventry: Becta. Available from: http://dera.ioe.ac.uk (Accessed: 22/05/14).

Bellanca, J, & Brandt, R. (2010) *21st learning skills: thinking how students learn*. Bloomington: Solution Tree Press.

Berings, M., Poell, R., Simons, P., & van Veldhoven, M. (2007) The development and validation of the On-the-job Learning Styles Questionnaire for the Nursing Profession. *Journal for Advanced Nursing*. 58 pp.480-492.

Biesta, G. (2012) Mixed methods. In: Arthur, J., Waring, M., Coe, R., & Hedges, L. (eds.) *Research methods & methodologies in education.* London: Sage Publishers. pp. 85-93.

Biggs, J. (1999) What the student does: Teaching for enhanced learning. *Higher Education Research & Development*. 18(1) pp.57-75.

Biggs, J., & Tang C. (2011) *Teaching for quality learning at university.* (4th ed.) Maidenhead: Open University Press.

Billett, S. (2001) *Learning in the workplace: Strategies for effective practice*. Sydney: Allen & Unwin.

Billett, S. (2002) Toward a workplace pedagogy: guidance, participation, and engagement. *Adult Education Quarterly*. 53(1) pp. 27-43.

Billett, S. (2009) Realising the educational worth of integrating work experiences in higher education. *Studies in Higher Education*. 34(7) pp.827-843.

Bingimlas, K. (2009) Barriers to the successful integration of ICT in Teaching and learning environments: A review of the literature. *Eurasia Journal of Mathematics, Science & Technology*. 5(3) pp.235-245.

Blaikie, N. (1993) *Approaches to Social Enquiry*. (2nd ed.) London: Polity Press.

Bliuc, A., Ellis, R., Goodyear, P., & Hendres, D. (2011) Understanding student learning in context: relationships between university students' social identity, approaches to learning, and academic performance. *European Journal of Psychology of Education.* 26(3) pp.417-433.

Boekaerts, M., & Minnaert, A., (1999) Self-regulation with respect to informal learning. *International Journal of Educational Research*. 31 pp.533-544.

Bolhuis, S. (2009) *Leren en veranderen*. (3rd ed.) Bussum: Coutinho.

Bolhuis, S., Buitink, J., & Onstenk, J. (2010) *Leren door werken in de school*. [Learning through work in school]. Uitgave in het kader van de Beleidsagenda Lerarenopleidingen van het Ministerie van OCW onder verantwoordelijkheid van de Interdisciplinaire Commissie Lerarenopleidingen (ICL).

Bonk, C., Graham, C., Cross, J., & Moore, M. (2006) *The handbook of blended learning: Global perspectives, local designs.* San Francisco, CA: Pfeiffer Publishing.

Borko, H., (2004) Professional development and teacher learning: Mapping the terrain. *Educational Researcher*. 33(8) pp.3–15.

Boud, D., & Middleton, H. (2003) Learning from others at work: communities of practice and informal learning. *Journal of Workplace Learning.* 15(5) pp.194-202.

Brannick, T., & Coghlan, D. (2007) In defense of being "native": The case of insider academic research. *Organizational Research Methods*. 10(1) pp.59-74.

Browaeys, M. (2004) Complexity of epistemology: Theory of knowledge or philosophy of science? In: *Fourth Annual Meeting of the European Chaos and Complexity in Organisations Network (ECCON*). Driebergen. pp.22-24.

Brown, A. (1992) Design experiments: Theoretical and methodological challenges in creating complex interventions in classroom settings. *Journal of the learning Sciences.* 2(2) pp.141- 178.

Bryant A., & Charmaz, K. (2007) Grounded Theory in historical perspective: An epistemological account. In: Bryant, A., & Charmaz, K. (eds.) *The Sage handbook of Grounded Theory* London: Sage Publications. pp.31-57.

Bryk, S., Sebring, P., Allensworth, E., Luppescu, S., & Easton, J. (2010) *Organising schools for improvement: Lessons from Chicago.* Chicago: University of Chicago Press.

Bryman, A. (2012) *Social research methods*. Oxford: Oxford University Press.

Bullock, D., (2004) Moving from theory to practice: An examination of the factors that pre-service teachers encounter as they attempt to gain experience teaching with technology during field placement experiences. *Journal of Technology and Teacher Education.* (12)2 pp.211-237.

Burgess, H., Sieminski, S., & Arthur, L. (2006) *Achieving Your Doctorate in Education*. London: Sage

Burr, V. (2003) *Social constructionism*. London: Routledge Taylor & Francis Group.

Butler, D., Novak Lauscher, H., Jarvis-Selinger, S., & Beckingham, B. (2004) Collaboration and self-regulation in teachers' professional development. *Teaching and Teacher Education Education.* 20 pp.435-455.

Butler, D. & Sellbom, M. (2002) Barriers to adopting technology for teaching and learning. *Educause Quarterly*. 2 pp.22–28.

Candy, P. & Candy, C. (1989) Alternative paradigms in educational research. *Australian Educational Researcher.* 16(3) pp:1–11.

Cassidy, S. (2004). Learning styles: An overview of theories, models, and measures. *Educational Psychology.* 24 pp.419–444.

Chalmers, L., & Keown, P. (2006) Communities of practice and professional development. *International Journal of Lifelong Education*. 25(2) pp.139–156.

Chambers, T. (2009) A continuum of approaches to service-learning within Canadian post-secondary education. *Canadian Journal of Higher Education.* 39(2) pp.77-100.

Charmaz, K. (2003) Grounded Theory In: Smith, J. (ed.) *Qualitative psychology: A practical guide to research methods*. London: Sage. pp. 81-110.

Charmaz, K. (2006) *Constructing Grounded Theory*. London: Sage.

Charmaz, K., & Bryant, A. (2012) *The Sage handbook of Grounded Theory*. London: Sage.

Charmaz, K. & Henwood, K. (2007) Grounded Theory in psychology. In: Willig, C., & Stainton-Rogers, W. (eds.) *Handbook of qualitative research in psychology*. London: Sage.

Charon, J. (2009) *Ten questions: A sociological perspective* (7th ed.) Belmont, CA: Wadsworth, Cengage Learning.

Clarke, D., & Hollingsworth, H. (2002) Elaborating a model of teacher professional growth. *Teaching and Teacher Education.* 18 pp.947-967.

Clarke, N. (2005) Workplace learning environment and its relationship with learning outcomes in healthcare organizations. *Human Resource Development International*. 8 pp.185-205.

Cobb, P., Confrey, J., Disessa, A., Lehrer, R., & Schauble, L. (2003) Design experiments in educational research. *Educational Researcher*. 32(1) pp.9-13.

Cofer, D. (2000), *Informal Workplace Learning, Practical Application Brief No. 10*. Columbus, OH: Centre of Education and Training for Employment.

Coffield, F., Moseley, D., Hall, E., & Ecclestone, K. (2004) *Learning styles and pedagogy in post-16 learning: A systematic and critical review.* London: Learning & Skills Research Centre.

Cohen, L., Manion, L., & Morrison, K. (2011) *Research Methods in Education*. London: Routledge.

Colley, H., Hodkinson, P., & Malcolm, J. (2002). *Non-formal learning: mapping the conceptual terrain, a consultation report.* Leeds: University of Leeds. Available from: http://www.infed.org/archives/e-texts/colley_informal_learning.htm (Accessed: 23/09/13)

Collins, A. (1992) Towards a design science in education. In: Scanlon, E., & O'Shea, T. (eds.) *New directions in educational technology.* Berlin: Springer. pp.15-22.

Collins, A., & Halverson, R. (2009) *Rethinking education in the age of technology: The digital revolution and schooling in America*. New York: Teachers College Press.

Commission of the European Communities (CEC) (1994) *Competitiveness, Employment, Growth.* Luxembourg: Office for Official Publications. Available from:

Commission of the European Communities (CEC) (1995) *Teaching and Learning: towards the learning society*. Luxembourg: Office for Official Publications.

Cordingley, P., Bell, M., Rundell, B. & Evans, D. (2003) *The impact of collaborative Continuing Professional Development (CPD) on classroom teaching*. London: EPPI Centre.

Coto, M., & Dirckinck-Holmfeld, L. (2008) Facilitating communities of practice in teacher professional development. In: Proceedings of the 6th International Conference on Networked learning. Halkidiki, Greece. 5-6 May 2008.

Cox, M. (1997) Identification of the changes in attitude and pedagogical practices needed to enable teachers to use information technology in the school curriculum. In: Passey, D., & Samways, B. (eds) *IFIP: Information Technology: supporting change through teacher education*. London: Chapman & Hall. pp.87-94.

Cox, M., Preston, C., & Cox, K. (1999) What motivates teachers to use ICT? In: British Educational Research Association Annual Conference. University of Sussex at Brighton Available from: http://www.leeds.ac.uk/educol/documents/00001329.htm.

Crabtree, B., & Miller, W. (1999) *Doing qualitative research.* (2nd ed) London: Sage Publications.

Cranton, P. (1996) *professional development as transformative learning*. San-Francisco: Jossey-Bass

Crawford-Ferre, H., & Wiest, L. (2012) Effective online instruction in higher education. *The Quarterly Review of Distance Education*. 13(1) pp.11–14.

Creswell, J. (2002) *Educational research: Planning, conducting, and evaluating quantitative and qualitative approaches to research.* Upper Saddle River, NJ: Merrill / Pearson Education.

Creswell, J., & Plano Clark, V. (2011) *Designing and conducting mixed methods research.* London: Sage Publications.

Cross, J. (2007) *Informal learning: Rediscovering the natural pathways that inspire innovation and performance*. San Francisco, CA: Pfeiffer.

Crossley, M. (2000) *Introducing narrative psychology: Self, trauma and the construction of meaning*. Buckingham: Open University Press.

Crotty, M. (1998) *The Foundations of Social Research: Meaning and perspectives in the research process*. London: Sage.

Cuban, L. (1995) Computers meet classrooms: Classroom wins. *Teacher College Records.* 95(2) pp.185-210.

Cuban, L. (2001) *Oversold and underused: Computers in classroom*. Cambridge: Harvard University Press.

Culp, K., Honey, M., & Mandinach, E. (2003) A Retrospective on twenty years of education technology policy. U.S. Department of Education, Office of Educational Technology. Available from: http://www.nationaledtechplan.org/participate/20years.pdf (Accessed: 12/04/2012).

Dale, M., & Belle, J. (1999) *Informal learning in the workplace*. Nottingham: Ecotech Research and Consulting.

Daly, C., Pachler, N., & Pelletier, C. (2009) *Continuing professional development in ICT for teachers: A literature review*. London: WLE Centre, Institute of Education, University of London.

Danziger, K. (1997) The varieties of social construction. *Theory and psychology*. 7(3) pp.399-416.

Darling-Hammond, L. (2006) Constructing 21st-century teacher education. *Journal of teacher Education*. 57(3) pp.300-314.

Darling-Hammond, L. (2010) Teacher Education and the American Future. *Journal of Teacher Education*. 61(1-2) pp.35-47.

Darling-Hammond, L., Chung Wei, R., Andree, A., Richardson, N., Orphanos, S. (2009) *A status report on teacher development in the United States and abroad*. Stanford: National Staff Development Council and the School Redesign Network at Stanford University.

Darling-Hammond, L., Holtzman, D., Gatlin, S., & Heilig, J. (2005) Does teacher preparation matter? *Education Policy Analysis Archives*. 13(42) pp.1-51.

Dawes, J. (2008) Do data characteristics change according to the number of scale points used?: An experiment using 5-point, 7-point and 10-point scales. *International Journal of Market Research*. 50(1) pp.61-77.

Day, C., Elliot, B., Kington, A. (2005) Reform standards and teacher identity: Challenges of sustaining commitment. *Teaching and Teacher Education*. 21(5) pp.563-577.

Dede, C. (2004) If design-based research is the answer, what is the question? *Journal of the Learning Sciences.* 13(1) pp.105-114.

Dede, C. (2010) Technological supports for acquiring 21st-century skills. In: Baker, E., McGaw, B., & Peterson, P. (eds.) *International encyclopaedia of education* (3rd ed.) Oxford: Elsevier.

Denzin, N., Lincoln, Y. (2000) *Handbook of qualitative research* (2nd ed.) London: Sage Publications.

Desimone, L. (2011) A primer on effective professional development. *Phi Delta Kappan.* 92 pp. 68–71.

Design Based Research Collective (DBRC) (2003) Design-based research: An emerging paradigm for educational inquiry. *Educational Researcher*. 32(1) pp.1-5.

De Wolf, A. (2002) *Onderwijsonderzoek en praktijk*. Tilburg: IVA, instituut voor sociaal wetenschappelijk beleidsonderzoek en advise.

Department for Education and Employment (DfEE) (1998) *The learning Age: a renaissance for a new Britain, Department for Education and Employment.* London: HMSO.

Dillenbourg, P., Järvelä, S., & Fischer F. (2009) The evolution of research on computer supported collaborative learning: From design to orchestration. In: Balacheff, N., Ludvigsen, S., de Jong, T., Lazonder, A., & Barnes, S. (eds.) *Technology Enhanced Learning*. Netherlands: Springer. pp. 3-19.

Dörnyei, Z., & Taguchi, T. (2010) *Questionnaires in second language research: Construction, administration and processing.* London: Lawrence Erlbaum

Drent, M., Meelissen, M. (2008) Which factors obstruct or stimulate teacher educators to use ICT innovatively? *Computers and Education*. 51(1) pp.187-199.

Dunn, T., & Shriner, C., (1999) Deliberate practice in teaching: What teachers do for self-improvement. *Teaching and Teacher Education.* 15 pp.631-51.

Dunne, C. (2011) The place of literature review in grounded theory research, International *Journal of Social Sciences*. 14 pp.111-124.

Earley, P., & Porritt, V. (2014) Evaluating the impact of professional development: The need for a student-focussed approach. *Professional Development in Education.* 40(1) pp.112-129.

Edgar, A., & Sedgwick. P. (2003) *Cultural Theory, The key concepts*. London: Routledge.

Eraut, M. (2004) Informal learning in the workplace. *Studies in Continuing Education*. (26)2 pp. 247-73.

Eraut, M. (2008) Using research into how professionals learn at work for enhancing placement learning. In: WACE/ACEN. *Proceedings of the WACE Symposium Sydney 2008*. Sydney: ACEN. pp.148-154.

Ericsson, K. (2006) The influence of deliberate practice on the development of superior expert performance. In: Ericsson, K., Charness, N., Hoffman, R., & Feltovich, P. (eds.) *The Cambridge handbook of expertise and expert performance*. Cambridge: Cambridge University Press. (pp.683-705).

Ericsson, K., *&* Simon, H. (1993) *Protocol analysis: Verbal reports as data.* Cambridge, MA: Bradford Books/ MIT Press.

Ertmer, P. (1999) Addressing first-and second-order barriers to change: Strategies for technology integration. *Educational Technology Research and Development*. 47(4) pp.7-61.

Ertmer, P., Ottenbreit-Leftwich, A. (2010) Teacher Technology Change: How knowledge, confidence, beliefs and culture intersect. *Journal of Research on Technology in Education*. 42(3) pp.255-284.

Eurostat (2006) *Classification of Learning activities manual.* Luxembourg: Office for Official Publications of the European Communities. Available from: http://ec.europa.eu. (Accessed:12/05/2015).

Evans, L. (2014) Leadership for professional development and learning: enhancing our understanding of how teachers develop. *Cambridge Journal of Education*. 44(2) pp.179-198.

Evans, K., Hodkinson, P., Rainbird, H., & Unwin, L. (2006) *Improving workplace learning.* London: Routledge.

Faux, J. (2010) Pre-testing survey instruments. Global Review of Accounting and Finance, 1(1), 100-111.

Feilzer, M. (2010) Doing mixed methods research pragmatically: implications for the rediscovery of pragmatism as a research paradigm. *Journal of Mixed Methods Research*. 4(1) pp.6-16.

Field, J. (2006) *Lifelong learning and the new educational order*. Stroke on Trent: Trentham Books.

Firestone, W., & Pennell, J. (1993) Teacher commitment, working conditions, and differential incentive policies. *Review of Educational Research*. 63 pp.489–525.

Fisher, G., Rohde, M., & Wulf, V. (2007) Community-based learning: The core competency of residential, research-based universities. *Computer-Supported Collaborative Learning.* 2(1) pp.9-40.

Fisher, R., & Katz, J. (2000) Social Desirability Bias and the Validity of Self-Reported Values. *Psychology & Marketing*. 17 pp.105-120.

Folkestad, G. (2006) Formal and informal learning situations or practices vs formal and informal ways of learning. *British Journal of Music Education*. 23(2) pp.135-145.

Forcheri, P. (2000) ICT Driven Individual Learning: New Opportunities and Perspectives. *Educational Technology & Society*. 3(1) pp.51-62.

Foulger, T. (2004) *Innovating professional development standards: A shift to utilize communities of practice*. Arizona: Arizona State University.

Fried, C. (2008) In-class laptop use and its effects on student learning. *Computers and Education.* 50(3) pp.906-914.

Frietman, J., Kennis, R., & Hövels, B. (2010) *Het managen van informeel leren: Hoe ver kun je gaan? Een verkennende studie naar kwaliteitsmanagement van het informeel leren van leraren. Rapport 6.* Heerlen: Open University, Ruud de Moor Centrum.

Fullan, M. & Stiegelbauer, S. (1991) *The new meaning of educational change*. New York: Teachers College Press.

Garet, M., Porter, A., Desimone, L., Birman, B., & Yoon, K. (2001) What makes professional development effective? Results from a national sample of teachers. American *Educational Research Journal*. 38 pp.915–945.

Gephart, R. (2004) Qualitative research and the Academy of Management Journal. *Academy of Management Journal*. 47(4) pp.454-462.

Gergen, K. (2009) An invitation to social construction (2nd ed.) London: Sage Publications.

Glaser, B. (1998) *Doing Grounded Theory: Issues and discussions*. Mill valley, CA: Sociology Press.

Glaser, B., & Holton, J. (2007) Remodeling grounded theory. *Historical Social Research / Historische Sozialforschung.* 19 pp.47-68.

Glaser, B., & Strauss, A. (1967) *The discovery of Grounded Theory*. New York: Aldine.

Glasset, K., & Schrum, L. (2009) Teacher beliefs and student achievement in technology-rich classroom environments. *International Journal of Technology in Teaching and Learning*. 5(2) pp.138-153.

Goktas, Y., Yildirim, S., & Yildirim, Z. (2009) Main Barriers and Possible Enablers of ICTs Integration into Pre-service Teacher Education Programs. *Educational Technology & Society*. 12(1) pp.193–204.

Goldman, A., "Social Epistemology", The Stanford Encyclopaedia of Philosophy (Summer 2010 Edition), Edward N. Zalta (Ed.), http://plato.stanford.edu/archives/sum2010/entries/epistemology-social.

Gorder, L. (2008) A study of teacher perceptions of instructional technology integration in the classroom. *Delta Pi Epsilon Journal*. 50(2) pp.63–76.

Gravemeijer, K. (1998) Developmental research as a research method. In: Kilpatrick, J., & Sierpinska, A. (eds.) *Mathematics education as a research Domain: A search for identity.* Dordrecht: Kluwer Academic publishers. pp.277-295.

Greene, J. (2007) *Mixed methods in social inquiry*. San Francisco: Jossey-Bass.

Groth, L., Dunlap, K., & Kidd, J. (2007) Becoming technologically literate through technology integration in PK-12 pre-service literacy courses: Three case studies. *Reading, Research and Instruction*. 46(4) pp.363-386.

Gummesson, E. (1999) *Qualitative methods in management research*. London: Sage.

Hager, P., & Halliday, J. (2007) *Recovering informal learning: Wisdom, judgement and community*. Dordrecht: Springer.

Hammersley, M. (2012) Methodological paradigms in educational research. *British Educational Research Association.* Available from: https://www.bera.ac.uk/wp-content/uploads/2014/03/Methodological-Paradigms.pdf?noredirect=1 (Accessed: 12/11/2014).

Hamlyn, D. (1995) Epistemology, history of. In: Honderich, T. (ed.) *The Oxford companion to philosophy*. Oxford: Oxford University Press. pp.242-245.

Hargreaves, A. (2003) *Teaching in the Knowledge Society: Education in the age of insecurity*. New York: Teachers College Press.

Hargreaves, A., & Finke, D. (2000) The three dimensions of reform. *Educational Leadership*. 57(7) pp.30-34.

Hargreaves, A., & Goodson, I. (2006) Educational change over time? The sustainability and nonsustainability of three decades of secondary school change and continuity. *Educational Administration Quarterly*. 42(1) pp.3-41.

Harris, J., Mishra, P., & Koehler, M. (2009) Teachers' technological pedagogical content knowledge and learning activity types: Curriculum-based technology integration reframed. *Journal of Research on Technology in Education*. 41(4) pp.393-416.

Hartley, P., Hilsdon, J., Keenan, C., Sinfield, S., & Verity, M. (2011) *Learning development in higher Education*. London: Palgrave MacMillan.

Hassler, B., Hennessy, S., Lubasi, B. (2011) Changing Classroom Practice using a School-Based Professional Development Approach to Introducing Digital Resources in Zambia. *Itupale Online Journal of African Studies*. 3 pp.17-31.

Hattie, J. (2005) What is the nature of evidence that makes a difference to learning? In: Australian Council for Educational Research. Melbourne: ACER. Available from: http://research.acer.edu.au/do/search/?q=hattie&start=0&context=473745 (Accessed:15/09/2014).

Hattie, J. (2012) *Visible learning for teachers: maximizing impact on learning*. Abingdon: Routledge

Hedström, P., & Udehn, L. (2009) Analytical sociology and theories of the middle range. In: Hedström, P., & Bearman, P. (eds.) *The Oxford Handbook of Analytical Sociology.* Oxford: Oxford University Press, 2009. pp.25-47.

Hennessy, S., Harrison, D., & Wamakote, L. (2010) Teacher factors influencing classroom use of ICT in Sub-Saharan Africa. *Itupale Online Journal of African Studies*. 2 pp.39-54.

Herrington, A. J. & Herrington, J. A. (2007) What is an authentic learning environment?. In: Tomei, L. (ed.) *Online and distance learning: Concepts, methodologies, tools, and applications*. Hershey, PA: Information Science Reference. pp.68-77.

Herrington, J., & Oliver, R. (2000) An instructional design framework for authentic learning environments. *Educational Technology Research and Development*. 48 pp.23–48.

Herrington, J., Reeves, T., & Oliver, R. (2014) Authentic Learning environments. In: Spector, J., Merrill, M., Elen, J., Bishop, M. (eds.) *Handbook of Research on Educational Communications and Technology*. New York: Springer. pp.401-412.

Hesse-Biber, S. (2007) Teaching grounded theory. In: Bryant, A., & Charmaz, K. (eds.) *The Sage Handbook of Grounded Theory*. London: Sage. pp.311-338.

Hesse-Biber, S., & Leavy, P. (2006) *The practice of qualitative research*. Thousand Oaks, CA: Sage.

Hoban, G. (2002) *Teacher learning for educational change: A systems thinking approach*. Buckingham Philadelphia: Open University Press.

Hoekstra, A., Beijaard, D., Brekelmans, M., & Korthagen, F. (2007) Experienced Teachers' formal learning from classroom teaching. *Teachers and Teaching*. 13(2) pp.191-208.

Hoffman, J. (2010) What we can learn from the first digital generation: implications for developing twenty-first century learning and thinking skills in the primary grades, Education 3-13: *International Journal of Primary, Elementary and Early Years Education*. 38(1) pp.47-54.

Holland, P. (2001) Professional development in technology: Catalyst for school reform. *Journal of Technology and Teacher Education*. 9(2) pp.245-267.

Holliday, R. and Retallick, J. (1995) *Workplace Learning: Module 2 – The Workplace as a Place of Learning*. Wagga Wagga: Charles Sturt University.

Holton, J. (2007) The coding process and its challenges. In: Bryant, A., & Charmaz, K. (eds.) *The Sage handbook of Grounded Theory*. London: Sage. pp.265-289).

Horsburgh, D. (2003) Evaluation of qualitative research. *Journal of Clinical Nursing.* 12(2) pp.307- 312.

Huebner, T. (2009) The Continuum of Teacher Learning. *Educational Leadership.* 66(5) pp.88-91.

Hughes, J. (2005) The Role of Teacher Knowledge and Learning Experiences in Forming Technology-Integrated Pedagogy. *Journal of Technology and Teacher Education*. 13 pp.277-302.

International Society for Technology in Education (ISTE) (2015) *Standards book bundle.* Arlington: ISTE.

Jarvis, P. (2006) *Towards a comprehensive theory of human learning*. Abingdon: Routledge.

Johnson, C. (2001) A survey of current research on online communities of practice. *Internet and Higher Education*. 4 pp.45–60.

Jung, I. (2005) ICT-Pedagogy integration in teacher training: Application cases worldwide. *Educational Technology & Society.* 8(2) pp.94–101.

Kali, Y. & Linn, M. (2008) Technology-enhanced support strategies for inquiry learning. In: Spector, J., Merrill, M., van Merriënboer, J., & Driscoll, M. (eds.) *Handbook of research on educational communications and technology.* (3rd ed.) New York: Lawrence Erlbaum Associates/Routledge. pp.145-161.

Kali, Y. & Ronen-Fuhrmann, T. (2011) Teaching to design educational technologies. *The International Journal of Learning and Technology*. 6(1) pp.4-23.

Kanuha, V. K. (2000) “Being” native versus “going native”: Conducting social work research as an insider. *Social Work* 45(5) pp.439-447.

Kehoe, R., & Wright, P. (2013). The impact of high-performance human resource practices on employees’ attitudes and behaviours. *Journal of Management*. 39(2) pp.366-391.

Kelly, A. (2003) Research as design. *Educational Researcher*. 32(1) pp.3-4.

Kelly, A. (2004) Design research in education: Yes, but is it methodological? *Journal of the Learning Sciences*. 13(1) pp.115-128.

Kennisnet (2011) *Vier in Balans Monitor 2011*. Zoetermeer: Kennisnet.

King, P. (2002) Educational technology professional development as transformative learning opportunities. *Computers and Education.* 39 pp.283-297.

King, M., & Newmann, F. (2000) Will teacher learning advance school goals*? Phi Delta Kappa.* 1 pp.576–580.

Kirakowski, J (1997) *Questionnaires in Usability Engineering. A List of Frequently Asked Questions.* Cork, Ireland: Human Factors Research Group. Available from: http://sumi.ucc.ie/index.html (Accessed: 19/06/2013).

Kiridis, A., Drossos, V. & Tsakidou, E. (2006) Teachers Facing ICT The Case of Greece. *Journal of Technology and Teacher Education*. 14(1) pp.75-96.

Kirkwood, A, & Price, L. (2014) Technology-enhanced learning and teaching in higher education: what is ‘enhanced’ and how do we know? A critical literature review. *Learning, Media and Technology*. 39(1) pp.6-36.

Kirschner, P., & Selinger M., (2003) The state of affairs of teacher education with respect to information and communication technology. *Technology, Pedagogy and Education* (12)1 pp. 5-17.

Kitsantas, A., & Dabbagh, N. (2011) The role of Web 2.0 technologies in self-regulated learning. *New Directions for Teaching and Learning*. 2011(126) pp.99-106.

Koehler, M. J., Mishra, P., & Yahya, K. (2007) Tracing the development of teacher knowledge in a design seminar: Integrating content, pedagogy and technology. *Computers & Education*. 49(3) pp. 740-762.

Kolb, A. Y., & Kolb, D. A. (2005) *The Kolb Learning Style Inventory—Version 3.1: 2005 technical specifications*. Boston: Hay Resources Direct. Available from: www.learningfromexperience.com (Accessed: 07/05/2014).

Kolis, M. (2013) *Rethinking teaching: Classroom teachers as collaborative leaders in making learning relevant*. Lanham: Rowman & Littlefield Education.

Kools, Q., Gootzen, M., Schols, M., Schildwacht, R., & Bouckaert-den Draak, M., (2012) Professional Development of Teacher Educators through Informal Learning. In: ATEE. *Book of Abstracts Winter Conference*. Coimbra, Portugal: ATEE.

Kozma, R. (2005) *ICT, education Reform, and economic growth*. Intel Corporation.

Kukla, A. (2000) *Social constructivism and the philosophy of science*. London: Routledge.

Kvale, S. (1996) *Interviews*. London: Sage.

Kvale, S., & Brinkmann, S. (2009) *Interviews: learning the craft of qualitative research interviewing.* London: Sage.

Kwakman, K. (2003) Factors affecting teachers' participation in professional learning activities. *Teaching and Teacher Education*. 19 pp.149-170.

Larossi, G. (2006) *The power of survey design: a user's guide for managing surveys, interpreting results, and influencing results*. Washington: The World Bank.

Laurillard, D. (2013) *Rethinking University Teaching: A conversational Framework for the effective use of learning technologies*. (2nd ed.) New York: RoutledgeFalmer.

Lave, J. & Wenger, E. (1991) *Situated learning: legitimate peripheral participation*. Cambridge: Cambridge University Press.

Lawless, K., & Pellegrino, J. (2007) Professional development in integrating technology into teaching and learning: Knowns, unknowns, and ways to pursue better questions and answers. *Review of Educational Research*. 77(4) pp.575-614.

Lefebvre, S., Deaudelin, D., & Loiselle, J. (2006) *ICT Implementation stages of primary school teachers: The practices and conceptions of teaching and learning.* In: AARE. Proceedings of the Australian Association for Research in Education National Conference. Adelaide, Australia: AARE annual. pp.1-25

Lei, J. (2009) Digital natives as preservice teachers: What technology preparation is needed? *Journal of Computing in Teacher Education*. 25(3) pp.87-97.

Le Maistre, C., & Paré A. (2004) Learning in two communities: The challenge for universities and workplaces. *Journal of Workplace Learning.* 16(1/2) pp.44-52

Lempert, L. (2007) Memo writing in Grounded Theory. In: Bryant, A., & Charmaz, K. (eds.) *The Sage Book of Grounded Theory*. London: Sage. pp. 245-264.

Levine, T., & Marcus, A. (2007) Closing the achievement gap through teacher collaboration: Facilitating multiple trajectories of teacher learning. *Journal of Advanced Academics*. 19(1) pp.116-138.

Levine, T., & Marcus, A. (2010) How the structure and focus of teachers' collaborative activities facilitate and constrain teacher learning. *Teaching and Teacher Education.* 26(3) pp.389-398.

Levitt, S., List, J. (2009) *Was there Really a Hawthorne Effect at the Hawthorne Plant? An Analysis of the Original Illumination Experiments.* NBER Working Paper 15016. Available from: http://www.nber.org/papers/w15016.pdf (Accessed: 09/03/2013).

Li, N., & Kirkup, G. (2007) Gender and cultural differences in Internet use: A study of China and the UK. *Computers & Education*. 48(2) pp.301-317.

Lieberman, A. & Pointer Mace, D. (2008) Teacher learning: the key to education reform. *Journal of Teacher Education*. 59(3) pp.226-234.

Lincoln, Y., Lynham, S., & Guba, E. (2011) *Paradigmatic controversies, contradictions, and emerging confluences revisited. The Sage handbook of qualitative research.* London: Sage Publications.

Linn, M., Davis, E. & Bell, P. (2004) *Internet environments for science education*. Mahwah, NJ: Lawrence Erlbaum Associates.

Linnenbrink, E., & Pintrich, P. (2003) The role of self-efficacy beliefs in student engagement and learning in the classroom. *Reading & Writing Quarterly: Overcoming learning difficulties.*19(2) pp.119-137.

Little, J. W. (2002) Locating learning in teachers' communities of practice: Opening up problems of analysis in records of everyday practice. *Teaching and Teacher Education. 18* pp.917–946.

Little, J. (2006) *Professional community and professional development in the learning-centred school.* Washington, DC: National Education Association.

Livingstone, S. (2012) Critical reflections on the benefits of ICT in education. *Oxford Review of Education*. 38(1) pp.9-24

Lohman, M. C. (2005) A survey of factors influencing the engagement of two professional groups in informal workplace learning activities. *Human Resource Development Quarterly*. 16 pp.501-527.

Lohman, M. (2006) Factors influencing teachers' engagement in informal learning activities. *Journal of Workplace Learning*. 19(3) pp.141-156.

Lohman, Margaret C. (2009) A survey of factors influencing the engagement of information technology professionals in informal learning activities. *Information Technology, Learning, and Performance Journal.* 25(1) pp.43-53.

Lohman, M. C., & Woolf, N. H. (2001) Self-initiated learning activities of experienced public school teachers: Methods, sources, and relevant organizational influences. *Teachers and Teaching*. 7 pp.59-74.

Lombardi Lombardi M. (2007) *Authentic learning for the 21st Century: an overview*. Educause Learning Initiative, ELI Paper. Available from: http://alicechristie.org/classes/530/ EduCause.pdf (Accessed: 12/05/2014).

Loo, R. (1997) Evaluating Change and Stability in Learning Style Scores. *Educational Psychology*. 17 pp.95-101.

Loucks-Horsley, S., Stiles, K., Mundry, S., Love, N., Hewson, P. (2009) *Designing professional development for teachers of science and mathematics.* Thousand Oaks: Corwin

MacDonald, R. (2008) Professional development for information communication technology integration: Identifying and supporting a community of practice through design-based research. *Journal of Research on Technology in Education.* 40(4) pp.429-445.

Markauskaite, L. (2007) Exploring the structure of trainee teachers' ICT literacy: The main components of, and relationships between, general cognitive and technical capabilities. *Educational Technology Research Development*. 55(6) pp.547-572.

Marsick, V. (2009) Towards a unifying framework to support informal learning theory, research and practice. *Journal of Workplace learning*. 21(4) pp.265-275.

Marsick, V., & Watkins, K., (1990) *Informal and incidental learning on the workplace*. London: Routledge.

Martin, P., & Turner, B. (1986) Grounded Theory and organizational research. *The Journal of Applied Behavioural Science.* 22(2) pp.141-157.

Matthews, P. (1999) Workplace learning: developing an holistic model. *The Learning Organization*. 6(1) pp.18-29.

Maynard, M. (1994) Methods, practice and epistemology: The debate about feminism and research. In: Maynard, M., & Purvis, J. (eds.) *Researching women's lives from a feminist perspective*. London: Francis Taylor. pp.10-26.

Mays, N. and Pope, C. (2000) Assessing quality in qualitative research. *British Medical Journal*. 320(7226) pp.50–52

McCotter, S. S. (2001) Collaborative groups as professional development. *Teaching and Teacher Education*. 17(6) pp.685-704.

McDermott, R. (2001) Knowing in community: 10 critical success factors in building communities of practice. *IHRIM Journal*. Available from: http://www.a-i-a.com/capital-intelectual/KnowingInCommunity.pdf (Accessed: 23/02/2013).

McLeod, P., & McLeod, A. (2004) Personal View if formal CME is ineffective, why do physicians still participate? *Medical Teacher*. 26(2) pp.184-186.

McKenney, S. (2001) *Computer-Based Support for Science Education Materials Developers in Africa: Exploring Potentials*. PhD Thesis. University of Twente. Available from: http://projects.edte.utwente.nl/cascade/seastudy/ (Accessed: 14/08/2012)

McKenney, S., & Nieveen, N., & Van den Akker, J. (2006) Design research from the curriculum perspective. In: Van den Akker, J., Gravemeijer, K., McKenney, S., & Nieveen, N. (eds.) *Educational Design Research*. London: Routledge. pp.67-90.

McKenney, S., & Reeves, T. (2012) *Conducting educational design research*. London: Routledge.

McLaughlin, M., (1997) Rebuilding teacher professionalism in the United States. In: Hargreaves, A., & Evans, R. (eds.) *Beyond educational reform. Bringing teachers back in*. Buckingham: Open University Press. pp.77-93.

McLaughin, M., & Talbert, J. (2006) *Building School-Based teacher Learning Communities: Professional Strategies to Improve Student Achievement.* Teachers College Press: New York and London.

McLoughlin,C., & Lee, M. (2010) Personalised and self-regulated learning in the Web 2.0 era: International exemplars of innovative pedagogy using social software. *Australasian Journal of Educational Technology*. 26(1) pp.28-43.

Means, B. (2010) Technology and education change: Focus on student learning. *Journal of Research on Technology in Education*. 42(3) pp.285-307.

Meirink, A., Meijer, P., Verloop, N., Bergen, (2009) Understanding teacher learning in secondary education: The relations of teacher activities to changed beliefs about teaching and learning. *Teaching and Teacher Education*. 25 pp.89-100.

Merriam, B., Caffarella, S., Baumgartner, L. (2007) *Learning in Adulthood: A Comprehensive Guide*. San Francisco: Jossey-Bass.

Mezirow, J., & Taylor, E. (2011) *Transformative learning in Practice: Insights form community, workplace, and higher education*. San Francisco: Jossey-Bass.

Miles, M., & Hubermann, M., (1994) *Qualitative data analysis: An expanded sourcebook.* London: Sage Publications.

Milken (1999) *Will new teachers be prepared to teach in a digital age?: A national survey on information technology in teacher education*. Santa Monica: Milken Family Foundation.

Mishra, P., & Koehler, M. (2006) Technological Pedagogical Content Knowledge: A Framework for Teacher Knowledge. *Teachers College Record*. 108(6) pp.1017-1054.

Moon, J. (2004) *Reflection in learning and professional development*. Abingdon: RoutledgeFalmer.

Mueller, J., Wood, E., Willoughby, Ross, C., & Specht, J. (2008) Identifying discriminating variables between teachers who fully integrate computers and teachers with limited integration. *Computers and Education*. 51(4) pp.1523-1537.

Mumtaz, S. (2000) Factors affecting teachers' use of information and communications technology: A review of the literature. *Journal of Information Technology for Teacher Education*. 9(3) pp.319-341.

Newman, D. (1990) Opportunities for research on the organizational impact of school computers. *Educational Researcher*. 19(3) pp. 8-13.

Niederhauser, D., & Stoddart, T. (2001) Teachers' instructional perspectives and use of educational software. *Teaching and Teacher Education*. (17)1 pp.15-31.

Nishii, L.H., & Wright, P. (2008) Variability at multiple levels of analysis: Implications for strategic human resource management. In: Smith, D. (ed.) *The people make the place.* Mahwah, NJ: Lawrence Erlbaum Associates.

Norman, G. (2010) Likert scales, levels of measurement and the ''laws'' of statistics. *Advances in Health Science Education*. 15(5) pp.625-632.

Oblinger, D., & Oblinger, J. (2005) *Is It Age or IT: First steps toward understanding the net generation*. Educause. Available from: www.educause.edu/educatingthenetgen. (Accessed:07/12/2012).

Onwuegbuzie, A., & Leech, N. (2009) Lessons learned for teaching mixed research: A framework for novice researchers. *International Journal of Multiple Research Approaches.* 3 pp.105-107.

Organisation for Economic Co-operation and Development (OECD) (2004) *Completing the Foundation for Lifelong Learning: An OECD survey of upper secondary Schools.* Innsbruck/Paris, OECD: Studienverlag.

Organisation for Economic Co-operation and Development (OECD) (2013) *Education at a Glance 2013: OECD Indicators.* OECD Publishing. Available from: http://dx.doi.org/10.1787/eag-2013-en. (Accessed: 04/07/2014).

Olson, K. (2010) An examination of questionnaire evaluation by expert reviewers. *Field Methods,22*(4), 295-318.

O'Neill, B. (2004) Collecting research data online: implications for Extension professionals. *Journal of Extension.* 42(3) Available from: http://www.joe.org/joe/2004june/tt1.php (Accessed: 18/02/2015).

Opfer, D., & Pedder, D. (2010) Access to Continuous Professional Development by teachers in England. *Curriculum Journal.* 21(4) pp.453-471.

Palfrey, J., & Gasser, U. (2008) *Born digital: Connecting with a global generation of digital natives.* New York: Basic Civitas Books.

Papert, S. (1990) Introduction. In: Harel, I. (ed.) *Constructionist learning*. Boston: MIT.

Parker, K., & Chao (2007) Wiki as a teaching tool. *Interdisciplinary Journal of Knowledge and Learning Objects*. 3(1) pp. 57-72.

Passey, & B. Samways (eds.) (1997) *Information Technology: Supporting change through teacher education.* London: Chapman and Hall.

Patton, M. (2002) *Qualitative research and evaluation methods*. Thousand Oaks, CA: Sage.

Park, S., Ertmer, P. (2008) Examining barriers in technology-enhanced problem-based learning: Using a performance support systems approach. *British Journal of Educational Technology*. 39(4) pp.631-643.

Pawson, R. (2008) Middle range theory and programme theory evaluation: *From provenance to practice*. In: Vaessen, J., & Leeuw, F. (eds). *Mind the Gap: Perspectives on Policy Evaluation and the Social Sciences*. Transaction Publishers.

Payne, G., & Grew, C. (2005) Unpacking "Class Ambivalence": Some Conceptual and Methodological Issues in Accessing Class Cultures. *Sociology.* 39(5) pp.893-910.

Pedro, F. (2007) The new millennium learners: Challenging our views on digital technologies and learning. *Digital Kompetanse*. 4 pp.244-263.

Penuel, W., Fishman, B., Yamaguchi, R., & Gallagher, L. (2007) What makes professional development effective? Strategies that foster curriculum implementation. *American Educational Research Journal.* 44(4) pp.921-958.

Pinder, C., & Moore., L. (2012) *Middle range theory and the study of organisations*. Boston/The Hague/London: Martinus Nijhoff Publishing

Pintrich, P., Marx, R., & Boyle, R. (1993) Beyond cold conceptual change: The role of motivational beliefs and classroom contextual factors in the process of conceptual change. *Review of Educational Research*. 63(2) pp.167-199.

Plomp, T., Nieveen, N. (2010) An introduction to educational design research. In: SLO. *Proceedings of the seminar conducted at the East China Normal University, Shanghai (PR China).* Enschede: SLO, Netherlands institute for curriculum development. pp.1 -126.

Powell, A. (2007) "Digital immigrants" teaching "digital natives". *Harvard News Office*. Available from: http://www.news.harvard.edu/gazette/2007/06.07/11-berkman.htm. (Accessed: 02/09/2013)

Prenksy, M. (2001) Digital natives, digital immigrants. *On the Horizon*. 9(5) pp.1–6.

Prensky, M. (2005) Engage me or enrage me. *EDUCASE Review*. 40(5) pp.61–64.

Prensky, M. (2006). *Don't bother me, Mom, I'm learning!: How computer and video games are preparing your kids for 21st century success and how you can help!* St. Paul: Paragon House.

Project Tomorrow, (2008) *21st century students deserve a 21st century education*. Available from: http://www.tomorrow.org/docs. (Accessed: 25/08/2012).

Punch, K. (2000) *Developing Effective Research Proposals,* London: Sage.

Putnam, R., & Borko, H. (2000) What do new views of knowledge and thinking have to say about research on teacher learning? *Educational Researcher*. 29(1) pp.4-15.

Raelin, J. (2001) Public reflection as the basis of learning. *Management Learning*. 32(1) pp.11 -30.

Reams, P., & Twale, D. (2008) The promise of mixed methods: Discovering conflicting realities in the data. *International Journal of Research and Method in Education.* 31(2) pp.133-142.

Reeves, T. (2000) Socially responsible educational research. *Educational Technology*, 40(6), 19-28.

Reeves, T. (2006) Design research from a technology perspective. In: Van den Akker, J., Gravemeijer, K., McKenney, S., & Nieveen, N. (eds.) *Educational design research* London: Routledge. pp.52-66.

Reeves, T., Herrington, J., & Oliver, R. (2005) Design research: A socially responsible approach to instructional technology research in higher education. *Journal of Computing in Higher Education.* 16(2) pp.97-116.

Reinking, D., & Bradley, B. (2008) *Formative and design experiments: Approaches to language and literacy research.* New York: Teachers College Press.

Resnick, M. (2002) Rethinking Learning in the Digital Age. In: Kirkman, G. (ed.) *The Global Information Technology Report: Readiness for the Networked Word.* Oxford: Oxford University Press. pp.32-37.

Richards, L. (2005) *Handling qualitative data: A practical guide*. London: Sage.

Richardson, V., & Placier, P. (2001) *Teacher change. In V. Richardson (Ed.), Handbook of research on teaching.* Washington, DC: American Educational Research Association.

Richey, R., Klein, J., & Nelson, W. (2004) Developmental research: Studies of instructional design and development. In: Jonassen, D. (ed.) *Handbook of research for educational communications and technology* (2nd ed.) Bloomington: Association for Educational Communications & Technology. pp.1099-1130.

Richey, R., & Nelson, W. (1996) Developmental research. In: Jonassen, D. (ed.) *Handbook of research for educational communications and technology*. New York: Macmillan. pp.1213-1245.

Roberts, B. (2003) *Using computers and technology in the social studies classroom: A study of practical pedagogy.* PHD Thesis. Georgia State University: Atlanta. Available from: http://search.proquest.com/docview/305602757 (Accessed: 15/04/2013).

Robinson, B., & Latchem, C. (2003) Teacher education: challenges and change. In: Robinson, B., & C. Latchem (eds.) *Teacher education through open and distance learning*. London: Routledge Falmer. pp.1-27.

Rockmore, T. (2005) *On constructivist epistemology*. New York: Rowman & Littlefield Publishers.

Romanelli, F., Bird, E., & Ryan, M. (2009) Learning styles: A review of theory, application, and best practices. *American Journal for Pharmaceutical Education*. 73(1) Article 9.

Rylatt, A. (1994) *Learning unlimited: Practical strategies and techniques for transforming learning in the workplace.* Sydney: Business and Professional Publishing.

Sabelli, N. (2008) Constructionism: A new opportunity for elementary science education. DRL Division of Research on Learning in Formal and Informal Settings. Available from: http://nsf.gov/awardsearch/showAwards.do? (Accessed: 12/012/2013). pp.193-206.

Sachs, J. (2001) Teacher Professional Identity: Competing Discourses, Competing Outcomes, *Journal of Education Policy*. 16(2) pp.149-161.

Sachs, J. (2003) *The activist teaching profession*. Buckingham: Open University Press.

Sadler, D. (2009) Situated learning in science education: socio-scientific issues as context for practice. *Studies in Science Education*. 45(1) pp.1-42.

Schildwacht, R. (2012) *Learning to notice: teachers coaching teachers with video feedback*. PHD Thesis. University of Twente: Enschede. Available from: https://www.utwente.nl/repository/utwente/dottwente/apps/search.shtml?folder=1448

Schoenfeld, A. (2006) Design experiments. In: Green, J., Camilli, G., Ellmore, P., & Skukauskaite, A. (eds.) *Handbook of Complementary Methods in Education Research*. Washington, DC: American Educational Research Association. pp.193-206.

Schoepp, K. (2005) Barriers to technology integration in a technology-rich environment. *Learning and Teaching in Higher Education: Gulf Perspectives*. 2(1) pp.1-24.

Schön, D. (1983) *The reflective practitioner: How professionals think in action*. New York: Basic Books

Schrum, L. (1999) TPD for teachers. *Educational Technology Research and Development.* 47 pp.83-90.

Schwandt, T. A. (2005) Constructivist, Interpretivist Approaches to Human Inquiry. In: O'Brian, J. (ed.) *The Production of Reality: Essays and Readings on Social Interaction* Seattle: Pine Forge Press.

Scribner, J., Sawyer, R, & Watson, S. (2007) Teacher teams and distributed leadership: A study of group discourse and collaboration. *Educational Administration Quarterly*. 43 pp.67–100.

Seale, C. (1999) Quality in qualitative research. *Qualitative Inquiry*. 5(4) pp.465-478.

Serrant-Green, L. (2002) Black on black: Methodological issues for black researchers working in minority ethnic communities. *Nurse Researcher*. 9(4) pp.30-44.

Shahmir, S., Hamidi, F., Bagherzadeh, Z., Salimi, L. (2011) Role of ICT in the curriculum educational system. *Procedia Computer Science*. 3 pp.623-626.

Shank, M. (2006) Teacher storytelling: A means for creating and learning within a collaborative space. Teaching and Teacher Education, 22, 711-721.

Sharan, B., Caffarella, S., Baumgartner, L. (2007) *Learning in Adulthood: A Comprehensive Guide*. San Francisco: Jossey-Bass.

Shaughnessy J., Zechmeister E., & Zechmeister J. (2000) *Research methods in psychology*. Boston, MA: McGraw-Hill Companies.

Sheehy, K., Clough, G. (2010) *Virtual worlds: Controversies at the frontier of education*. Hauppauge: Nova Science Publishers.

Shulman, L. (1986) Those who understand: Knowledge growth in teaching. *Educational Researcher*. 15 pp 4-14.

Shulman, L. (1987) Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review*. 57 pp.1-22.

Siadaty, M., Gašević, D., Jovanović, J., Pata, K., Milikić, N., Holocher-Ertl, T., Jeremić, Z., Ali, L., Giljanović, A., & Hatala, M. (2012) Self-regulated Workplace Learning: A Pedagogical Framework and Semantic Web-based Environment. *Journal of Educational Technology & Society*. 15(4) pp.75-88.

Sieber, J., & Tolich, M. (2012) *Planning ethically responsible research*. London: Sage Publications.

Sife, A., Lwoga, E., & Sanga, C. (2007) New technologies for teaching and learning: Challenges for higher learning institutions in developing countries. *International Journal of Education and Development using ICT*. 3(2) pp.

Siggelkow, N. (2007) Persuasion with case studies. *Academy of Management Journal*. 50(1) pp.20-24

Sloep, P., & Jochems, W., (2007) De e-lerende burger [The e-learning citizen]. In: Steyaert, J., & Haan, J. (eds.) *Jaarboek ICT en samenleving 2007*. Amsterdam: Boom. pp.171-187.

Smith, M. (2008) Informal learning. *The encyclopaedia of informal learning*. Available from http://infed.org (Accessed: 10/05/2013).

Snoeyink, R., & Ertmer, P. A. (2002) Thrust into technology: how veteran teachers respond. *Journal of Educational Technology Systems*. 30(1) pp.85-111.

Stahl, G. (2006) *Group cognition: Computer support for building collaborative knowledge.* The Cambridge MA: MIT Press.

Stensaker, B., Maasen, P., Borgan, M., Oftebro, M., & Karseth, B. (2007) Use, updating and integration of ICT in higher education: Linking purpose, people and pedagogy. *Higher Education*. 54(3) pp.417-433.

Stenström, M. (2006) Polytechnic graduates working life skills and expertise. In: Tynjälä, P., Välimaa, J., & Boulton-Lewis, G. (eds.) *Higher education and working life: Collaborations, confrontations and challenges*. Amsterdam: Elsevier. pp.89–102.

Strauss, A. (1987) *Qualitative analysis for social scientists*. Cambridge: Cambridge University Press.

Strauss, A., & Corbin, J. (1998) *Basics of qualitative research: Procedures and techniques*. (2nd ed.) Thousand Oaks, CA: Sage.

Talja, S., Tuominen, K., & Salvolainen, R. (2005) "Isms" in information science: constructivism, collectivism, and constructionism. *Journal of Documentation*. 61(1) pp.79-101.

Tashakkori, A. & Teddlie, C. (1998) Mixed methodology: Combining qualitative and quantitative approaches. *Applied Social Research Methods Series, 46*. Thousand Oaks CA: Sage Publications.

Teddlie, C., & Tashakkori, A. (2003) *Handbook of mixed methods in social & behavioural research.* Thousand Oaks, CA: Sage Publications.

Tezci, E., (2011) Factors that influence pre-service teachers' ICT usage in education. *European Journal of Teacher Education*. (34)4 pp.483-499.

The United States Department of Education (2005) *Toward a new golden age in American education: How the Internet, the law and today's students are revolutionizing expectations.* Available from http://www.ed.gov (Accessed: 08/02/2012).

Thomas, D. (2006) A general inductive approach for analysing qualitative evaluation data. *American Journal of Evaluation*. 27(2) pp.237-246.

Thornberg, R. (2012) Grounded Theory. In: Arthur, J., Waring, M., Coe, R., & Hedges, L. (eds.) *Research methods & methodologies in education.* London: Sage Publishers. pp.85-93.

Timperley, H. Wilson, A., Barrar, H. & Fung, I. (2008) *Teacher professional learning and development: Best evidence synthesis iteration.* New Zealand: Ministry of Education. Available from: http://www.educationcounts.govt.nz/__data/assets/pdf_file/0017/16901/TPLandDBESentireWeb.pdf (Accessed: 27/10/2014).

Tondeur, J., Braak, J., Valcke, M. (2007) Curricula and the use of ICT in education: Two worlds apart? *British Journal of Educational Technology*. 38(6) pp.962-976.

Tondeur, J., Keer, H., Braak, J., Valcke, M. (2008) ICT integration in the classroom: challenging the potential of a school policy. *Computers and Education*. 51 pp.212-223.

Tondeur, J., Braak, J., Van der Linde, R., Thys, J., Roo de, N. (2010) ICT-integratie in de lerarenopleiding: Vier in balans? *Tijdschrift voor lerarenopleiders (VELON / VELOV)*. 31(2) pp.11-18.

Traxler, J. (2009) Learning in a mobile age. *International Journal of Mobile and Blended learning*. 1(1) pp.1-12.

Tynjälä, P., Välimaa, J., & Sarja, A. (2003) Pedagogical perspectives on the relationships between higher education and working life. *Higher Education*. 46(2) pp.147-166.

Tynjälä, P. (2008) Perspectives into learning in the workplace. *Educational Research Review*. 3(2) pp.130-154.

Tynjälä, P., Slotte, V., Nieminen, J., Lonka, K., & Olkinuora, E. (2006) From university to working life: Graduates' workplace skills in practice. In: Tynjälä, P., Välimaa, J., & Boulton-Lewis, G. (eds.) *Higher education and working life: Collaborations, confrontations and challenges.* Amsterdam: Elsevier. pp.73–88.

UNESCO. (2010) *ICT transforming education: a regional guide in Teacher Education: Case Studies from the Asia-Pacific Region*. Bangkok: UNESCO. Available from: http://unesdoc.unesco.org/images/0018/001892/189216e.pdf. (Accessed: 26/07/2013).

Valcke, M., Rots, I., Verbeke, M., & Braak, J., (2007) ICT teacher training: Evaluation of the curriculum and training approach in Flanders. *Teaching and Teacher Education*. 23 pp. 795-808.

Van Aken, J., & Andriessen, D. (2011) *Handboek ontwerpgericht wetenschappelijk onderzoek: Wetenschap met effect.* Den Haag: Boom Lemma.

Van den Akker, J. (1999) Principles and methods of development research. In: Van den Akker, J., Branch, R., Gustafson, K., Nieveen, N., & Plomp, T. (eds.) *Design Approaches and tools in education and training*. Dordrecht: Kluwer Academics. pp.1-14.

Van den Akker, J., Gravemeijer, K., McKenney, S., & Nieveen, N. (2006*) Educational Design Research.* London: Routledge.

Van Driel, J., Berry, A. (2012) Teacher Professional Development Focusing on Pedagogical Content Knowledge. *Educational Researcher*. 41(1) pp.26-28.

Van Es, E. (2009) Participants' roles in the context of a video club. *Journal of the Learning Sciences*. 18(1) pp.100-137.

Van Veen, W. (2009) *Homo Zappiens*. Amsterdam: Pearson Education Press.

Van der Linde, R., Braak, J., Dexter S. (2012) ICT policy planning in the context of curriculum reform: Disentanglement of ICT policy domains and artefacts. *Computers and Education*. 58 pp.1339-1350.

Van Woerkom, M., Nijhof, W., & Nieuwenhuis, L. (2001) Critical reflective working behaviour: a survey research. In: Streumer, J. (ed.) *Perspectives on learning at the workplace: Theoretical positions, organizational factors, learning processes and effects*. Enschede: University of Twente. pp.3–16.

Veen, W., & Vrakking, B. (2006) *Homo Zappiens: Reshaping learning in the digital age*. London: Network Continuum.

Vermetten, Y., Lodewijks, H., & Vermunt, J. (1999) Consistency and variability of learning strategies in different university courses. *Higher Education*. 37 pp.1-21.

Vermunt, J. (1996) Metacognitive, cognitive, and effective aspects of learning styles and strategies: A phenomenographic analysis. *Higher Education*. 31 pp.25-50.

Vermunt, J. (1998) The regulation of constructive learning processes. *British Journal of Educational Psychology*. 68 pp.149–171.

Vermunt, J. (2005) Relations between student learning patterns and personal and contextual factors and academic performance. *Higher Education*. 49(3) pp.205-234.

Vermunt, J., & Vermetten, Y. (2004) Patterns in student learning: Relationships between learning strategies, conceptions of learning, and learning orientations. *Educational Psychology Review.* 16 pp.359-384.

Vernacchia, A. (2012) *The Effects of Microblogging in the Classroom on Communication*. Unpublished Master of Science thesis, Purdue University

Von Glasersfeld, E. (1989) Constructivism. In: Husen, T., & Postlethwaite, T. (eds.) *The international encyclopedia of education.* Oxford: Pergamon. pp. 162-163.

Von Glasersfeld, E. (1990) Environment and communication. In: Steffe, L., & Wood, T. (eds.) *transforming children's mathematics education.* Hillsdale, NJ: Erlbaum. pp.30-38.

Von Glasersfeld, E. (1995) Sensory experience, abstraction, and teaching. In: Steffe, L., & Gale T. (eds.) *Constructivism in education.* New Jersey: Lawrence Erlbaum. pp.369-384.

Wademan, M. (2005) *Utilizing Development Research to Guide People Capability Maturity Model Adoption Considerations*. PHD Thesis. Syracuse University (New York, USA).

Walker, D. (2006) Toward productive design studies. In: Van den Akker, J., Gravemeijer, K., McKenney, S., & Nieveen, N. (eds.) *Educational design research.* London: Routledge. pp.8-13.

Wang, F. & Hannafin, M. (2005) Design-based research and technology-enhanced learning environments. *Educational Technology Research and Development*. 53(4) pp.5-23.

Wang, T. (2009) The Transformational Promise of Information and Communications Technologies (ICTs) for the Professional Education of Architects. *Journal of Educational Technology & Society*.12(3) pp. 206-213.

Waring, M. (2012) Grounded Theory. In: Arthur, J., Waring, M., Coe, R., & Hedges, L. (eds.) *Research methods & methodologies in education.* London: Sage Publishers. pp.297 -308.

Way, J., & Webb, C. (2007) A framework for analysing ICT adoption in Australian primary schools. *Australasian Journal of Educational Technology*. 23(4) pp.559-582.

Webster-Wright, A. (2009) Reframing professional development through understanding authentic professional learning. *Review of Educational Research*. 79(2) pp.702-739.

Wenger, E. (1998) *Communities of practice*. Cambridge: Cambridge University Press.

Wenger, E., McDermott, R., Snyder, W., (2002) *A guide to managing knowledge. Cultivating Communities of Practice.* Boston, Massachusetts: Harvard Business School Press.

Wickström, G., Bendix, T. (2000) The "Hawthorne effect" - what did the original Hawthorne studies actually show? *Scand Work Environ Health.* 26(4) pp.363-367.

Wilson, S., & Berne, J., (1999) Teacher learning and the acquisition of professional knowledge: an examination of research on contemporary professional development. *Review of Research in Education*. 24 pp.173-2009.

Wiske, M. (2006) Teaching with meaningful learning with new technology In: Ashburn, E., A, & Floden, R. (eds.), *Meaningful learning using technology: What educators need to know and do*. New York: Teachers College Press. pp.26-43.

Walford, G. (2009) The practice of writing ethnographic field notes. *Ethnography and Education*. 4(2) pp.117-130.

Yin, R. (2003) *Case study research: Design and methods* (3rd ed.) Thousand Oaks, CA: Sage.

Yoon, K., Duncan, T., Lee, S., Scarloss, B., & Shapley, K. (2007). *Reviewing the evidence on how teacher professional development affects student achievement (Issues and Answers Report, REL 2007 No. 033).* Washington, DC: U.S. Department of Education, Regional Educational Laboratory Southwest.

Zhao, Y., Pugh, K., Sheldon, S., & Byers, J. (2002) Conditions for classroom technology innovations. *Teachers College Record.* 104(3) pp.482-515.

Zhao, C.,&Kuh, G. (2004) Adding value: Learning communities and student engagement. *Research in Higher Education*. 45 pp.115-138.